THE AEROPLANE and ASTRONAUTICS

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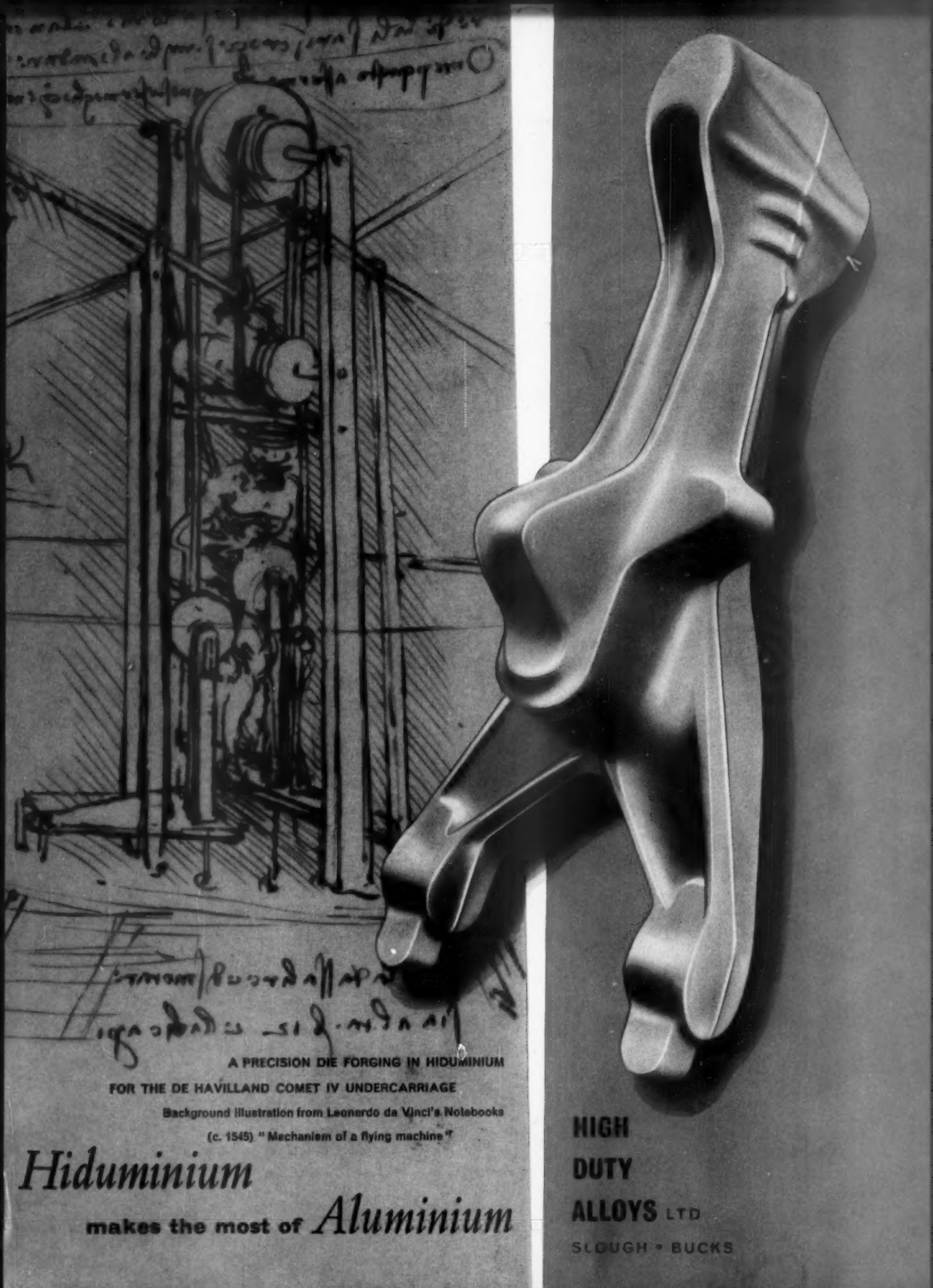

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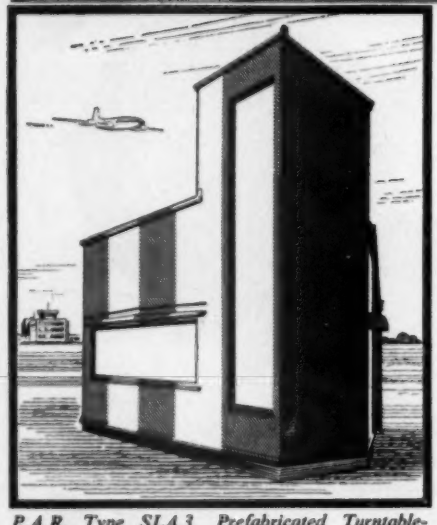

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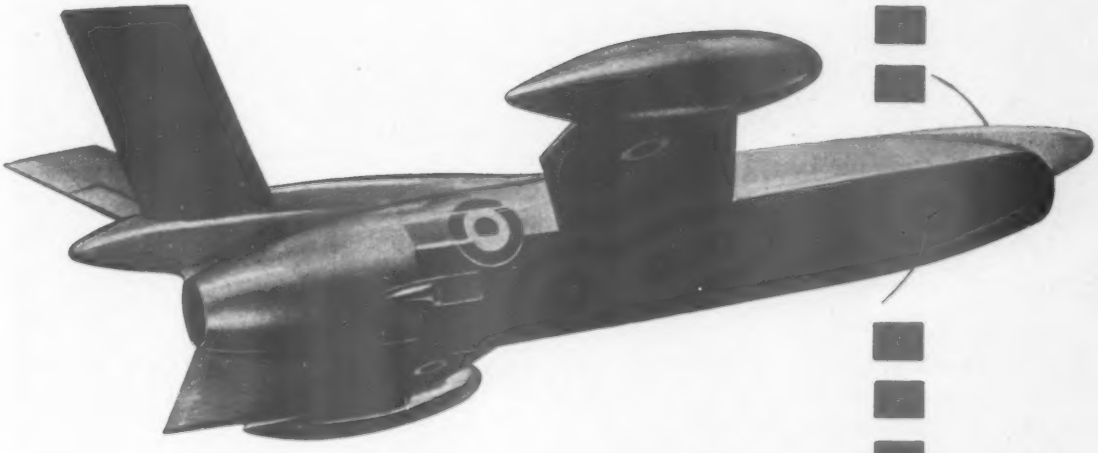

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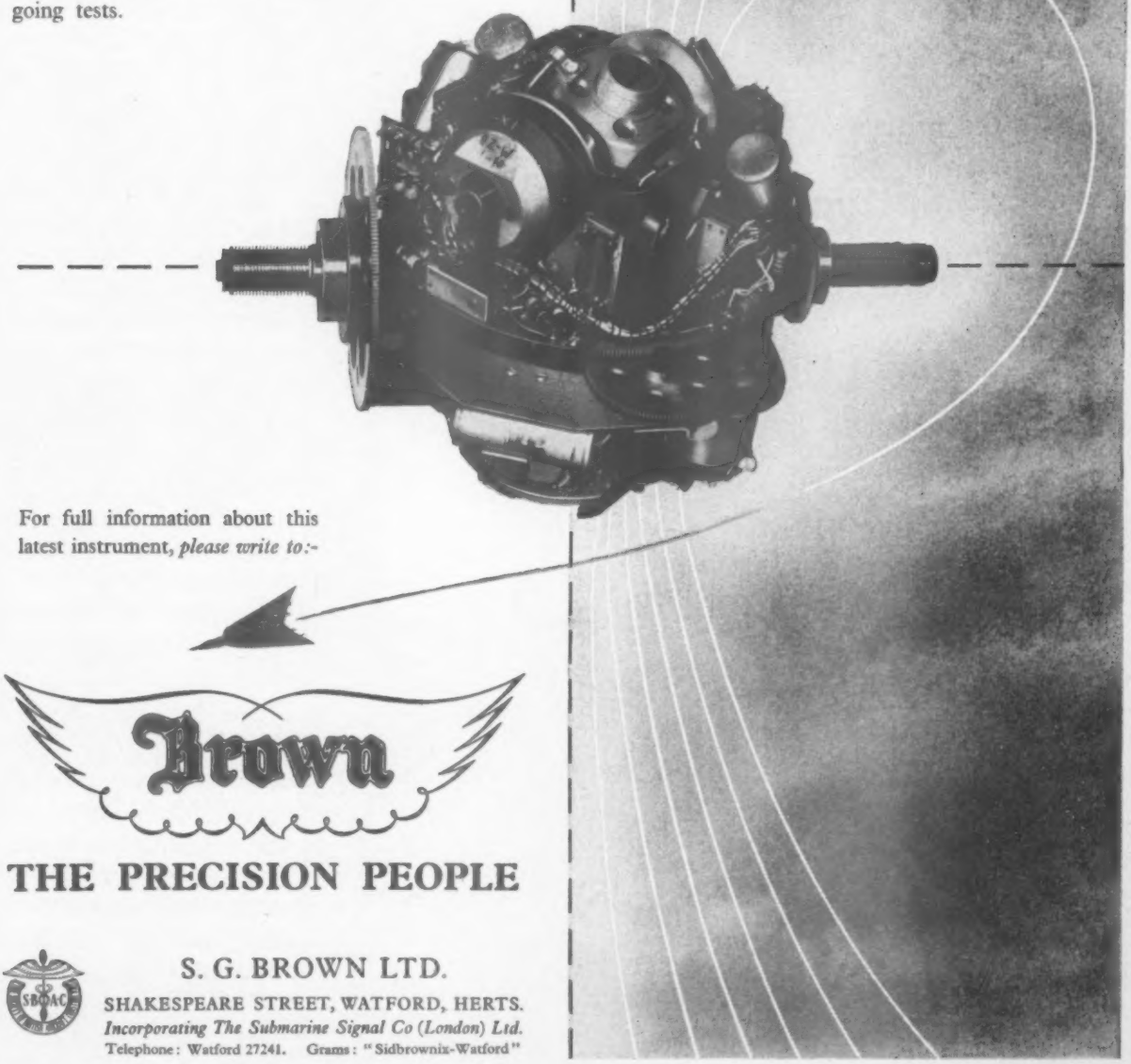

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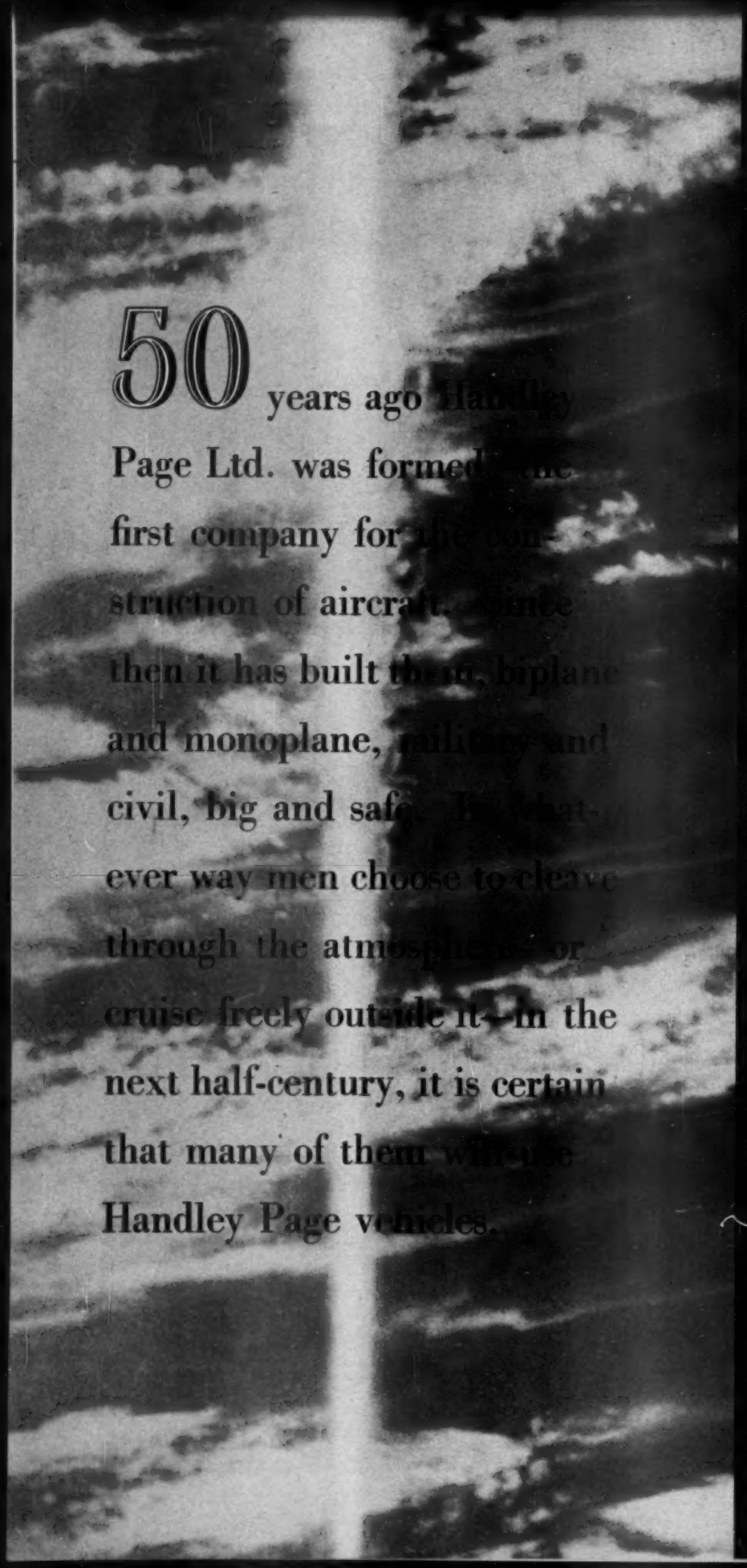

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THE AEROPLANE and ASTRONAUTICS

VOLUME 96 NUMBER 2493 JUNE 12, 1959

Le Cinquantenaire du Salon

TODAY, June 12, the *Salon International de l'Aéronautique* opens for the 23rd time since its inauguration in 1909. May we congratulate the *Union Syndicale des Industries Aéronautiques* and, in particular, M. André Granet, who has been commissioner-general of the Salon since its creation as the *Exposition Internationale Locomotion Aérienne* in the Grand Palais, Paris, 50 years ago. In that year the Blériot monoplane, one of which had just flown the Channel, was one of the centres of attraction; this year it appears that a very different type of aircraft, the Coleopter—that unique annular-wing device by SNECMA, with VTOL characteristics—will dominate the exhibition.

In its own special way the Paris Salon has probably done more for World aviation than any other event or circumstance. In the pre-1914 era exhibitions were held in successive years until 1913, bringing together the enthusiasts as well as the designers and manufacturers. Between the Wars the Salon was held in alternate years and this pattern has, with one exception, been followed until now.

The exhibitions were held in the Grand Palais from 1909 until 1949, when the addition of a separate "*présentation dynamique*" at Orly marked the first change in the pattern. In 1951 this flying display moved to Le Bourget and in 1953 the entire show, static and dynamic, was moved out to this historic airport where a special exhibition building had been constructed and since enlarged.

Support for Exports

NO achievement in the field of civil aviation has been more solidly spectacular than the development and sale in the international market of the Vickers Viscount. As we recently reported, the four hundredth aircraft of this type was handed over to the internationally known independent air transport operator Hunting-Clan at Wisley on May 29.

In the course of his reply to the address made by Sir George Edwards, Mr. P. Ll. Hunting, chairman of the Hunting group of companies and chairman of Hunting-Clan Air Transport Ltd. made some important points. First he was concerned to emphasize the need for more personal attention to civil aviation affairs than can be given by the present Minister of Transport who, he calculated, is probably unable to give as much as one-tenth of his attention to this aspect. He would like to see a Minister of State in charge of civil aviation but within the Ministry of Transport. He was concerned lest in fifteen years British civil air transport should have got into the hands of the foreigner. To ensure that the Ministry's activities were not restrictive, he wished to see a new act on the statute book which rather than the present Air Corporations Act would begin something like this: "To encourage, develop and promote British civil aviation in all its aspects." He also stressed the importance of lowering air fares. It will be seen that all this is tantamount to freeing civil aviation from restriction.

On the subject of low fares, we suppose that no single unit has done more to reduce the costs of civil air transport than has the Vickers group with the successful introduction of the Viscount turboprop and now the development of the second generation turboprop, the Vickers Vanguard, encouraging progress of which we were able to report last week.

Special importance must therefore be attached to the remarks

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which the Viscount Knollys, G.C.M.G., M.B.E., D.F.C., chairman of Vickers Ltd., made at the annual general meeting in London on June 1. He recalled that last year he made an appeal to the Government for the strengthening of R.A.F. Transport Command to be carried out in a way which would give the maximum benefit to the civil types already under consideration. This year he stressed the need for the Government to appreciate the great and disproportionate financial burden which aircraft constructors have to carry in privately financed ventures such as the Vanguard and the V.C.10.

The difficulties with which the British aircraft industry are confronted can be identified closely with the strength of competition, particularly from the United States. What the British industry looked for was the same kind of practical far-seeing support which the U.S. Government affords to its own private-enterprise aircraft industry.

He concluded this section of his speech by emphasizing that without firm and early support by the Government, through R.A.F. orders or otherwise, to back up the initiative of private enterprise in maintaining design and production facilities and in forward planning, Great Britain is more than likely, and that sooner than many people expected, to find itself without a real aircraft industry at all.

The inevitable consequences would be the loss of a great industry with its international prestige, the loss of technological talent, the loss of employment and the loss of large, all-important exports. In the case of Vickers, Ltd., aircraft to the value of £100,000,000 had in the past four years been sold to overseas customers.

The aircraft now being displayed at Le Bourget are for sale in international markets. There is no closed shop for the building of aircraft and this is a fact which is forcibly emphasized at international aero shows. The recent opening of the air link between Moscow and London has focused attention on the achievements in the civil aircraft field of Soviet Russia. In that country turbojets and turboprops are in busy everyday service. The Western world has no monopoly and in consequence, unless Great Britain is to fall far behind in the struggle, the words of Lord Knollys must not only be heard but acted upon.

400th VISCOUNT.—At a ceremony at Wisley on May 29, the 400th Viscount to be sold and completed was handed over by Vickers to Hunting-Clan. Sir George Edwards is here presenting a model of the V.833 to Mr. P. Ll. Hunting.

AN APOLOGY

Owing to production difficulties which are beyond our control we regret that it has been necessary to curtail the number of editorial and advertisement pages in recent issues. We hope that readers and advertisers will accept our apologies for the omission of some usual features and for such abridged reports of events as may be necessary while these difficulties remain.

THE R.A.F.'s TURBOPROP TRANSPORT.—A Britannia for Transport Command on engine test at Short Brothers and Harland's Queen's Island Works, Belfast. Two examples of the R.A.F.'s Britannia will be seen at Le Bourget during the Paris Show

Matters of Moment

Aero-exports for April

DESPITE authoritative warnings that a decrease is to be expected in British aero-exports, there are few signs as yet of this effect of the cut-back in military orders. Indeed, the latest figures to be published—those for April—still show a rising trend.

During the first four months of this year the aircraft industry exported almost £60 million worth of goods, which represented a monthly average of nearly £15 million and an annual rate of £175 million compared with last year's record £154 million.

The April figure—£17,335,559—was the second highest monthly total ever achieved (the highest was £17.5 million in December, 1957). The aircraft and parts total at £11,258,283 was the second highest ever recorded and the aero-engine figure —at £5,417,506—was a record. Electrical parts and appliances amounted to £357,963, tyres, £60,977, and aeronautical instruments, £240,830.

Leading buyers of aircraft and parts during April were India, £2,182,113; West Germany, £1,832,468; Canada, £1,304,699; the United States, £1,215,985; Australia, £1,208,535, and Switzerland, £1,172,292.

The January-April total of £58,374,165 showed an increase of 16% over last year's equivalent figure, which was a record, and a gain of 78% over the 1957 four-monthly total. The aircraft and parts figure—£36,387,719—was 10% up on last year, and the aero-engine total—£19,403,111—was 25% up on the equivalent 1958 figure. Electrical parts and appliances (£1,383,189), tyres (£288,921) and aeronautical instruments (£911,225) showed a combined gain of 37% over last year's equivalent total.

During this period leading buyers of aircraft and parts were India, £5,955,837; West Germany, £4,323,275; Argentina, £2,891,944; the United States, £2,818,922; Switzerland, £2,477,342 and Australia, £2,044,250.

News about Seaslug

A FILM shown by Armstrong Whitworth on June 2 gave evidence that their Seaslug SAM is a beam-rider. One of the shots was of a salvo of two Seaslugs being fired, seconds apart, from the trials ship, H.M.S. "Girdle Ness," at a target aircraft. The missiles followed a rolling corkscrew course as they passed up the beam locked on to the target, which was duly destroyed.

In current Seaslug tests the missiles are programmed to miss the target aircraft by a predetermined distance, because their accuracy has been proved in previous tests and the supply of target aircraft is limited. In successive firings at Woomera two Seaslugs with live warheads each destroyed a jet-propelled target aircraft.

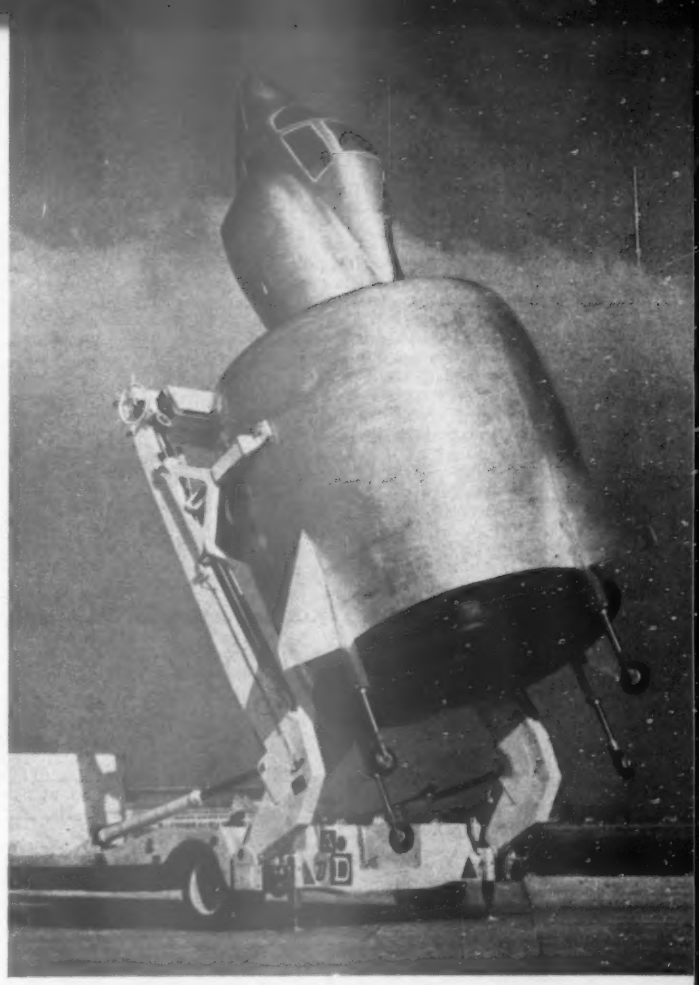
Guidance and control systems of Seaslug have been developed by General Electric and Sperry respectively. The missile will equip the four "Hampshire"-class guided-weapon destroyers now on order for the Royal Navy. Although these ships are unlikely to be in service until 1962, Armstrong Whitworth states that they will have the current operational versions of Seaslug and not the more advanced versions which are under development.

A Set-back for Nike

FROM America come reports that a much modified programme for the Nike-Hercules surface-to-air missile has been put forward by the Senate Armed Services Committee. To begin with it appears that the Committee has proposed that the U.S. Army's planned £8-million budget for the development of these missiles be cut to only £2 million. Secondly it is reported to have cancelled permission that was given earlier to the Army to set up 50 Nike-Hercules bases in the United States and eight in Hawaii.

Not unnaturally these major restrictions have brought some sharp criticism from the Army. The proposal, it has been said, seriously endangers the future security of the country because Nike-Hercules with a 75-100-mile range is the only suitable anti-aircraft missile available to bridge the two-year gap before Bomarc is ready for service. Nike-Hercules is, in fact, an intermediate missile between the 25-mile Nike-Ajax at present mounted in operational batteries round all major American cities, and the 200-400-mile ramjet-powered Bomarc.

In Washington there have been reports that the Nike-Hercules did not appear particularly effective during a mock attack by bomber aircraft against Chicago last autumn. Indeed an effectiveness of only 8% has been quoted.



SHOW HIGHLIGHT.—A VTOL aircraft project with an annular wing that is likely to be one of the highlights of this year's Paris Aero Show at Le Bourget, is the SNECMA Coleoptère designed by von Zborowski. Here it is poised on its special servicing trolley.

No comments in this connection were forthcoming by the Army but it was emphasized that the Senate Committee's restrictions would immediately stop production of equipment for 54 Nike-Hercules batteries and their missiles. Strategic bomber bases, large cities and industrial centres would be left inadequately defended and Hawaii would be left defenceless so far as surface-to-air missiles were concerned.

Crop-spraying by B.E.A.

ALTHOUGH agricultural operations are apparently far removed from the primary function of B.E.A.'s Experimental Helicopter Unit, which under the direction of Capt. J. A. Cameron is busily developing all-weather flying techniques for eventual scheduled services with large passenger-carrying rotorcraft, they are being undertaken on an increasing scale this year following a successful season in 1958.

Last summer will long be remembered by farmers and crop-spraying concerns for the potato blight accompanying the heavy rainfall, and B.E.A. entered the agricultural business on an emergency basis, to help combat the ravages of the epidemic. One of its three Westland-Sikorsky S.55s was fitted with spray gear designed and manufactured by the B.E.A. unit personnel, and in little more than six weeks treated more than 8,000 acres in Lincolnshire and Essex.

Despite the fact that helicopters as large as the S.55 had not previously been used for crop-spraying in this country, these operations contributed a great deal to the small profit made last year by the Helicopter Unit, which receives no Government subsidy. Last year, the B.E.A. S.55 achieved a coverage of 68 acres per flying hour, including all positioning flying, and this season the aim is 100 acres/hr. This increase will partially be achieved by an increase in the spray-bar width from 23 to 30 ft. with a corresponding swath width of 100 instead of 75 ft.

The high ratio of swath to spraybar width is attributed to the mounting of the nozzles well forward of the helicopter

Matters of Moment . . . .

nose, instead of the more usual midships location. This development was pioneered by the B.E.A. Unit, which has also introduced P.V.C. plastic as an anti-corrosive alternative to stainless steel for chemical tanks and spray-bars, with a great saving in weight.

The total installed weight of the spraying equipment on the S.55, including the 110-gal. metal chemical tank in the process of being replaced by P.V.C., is only 230 lb., and the agricultural payload, with 60 gal. of fuel, is therefore in the region of 1,500 lb. The S.55 is then operating about 250 lb. below its maximum gross weight, and is able to fly two 20-min. sorties before refuelling. Its optimum spraying speed is about 30 m.p.h., and the agricultural gear apparently has little effect on its handling qualities.

While encouraging the use of bigger helicopters for spraying, the B.E.A. unit is not neglecting the smaller types, and is to operate its Bell 47B-3 on agricultural duties in Scotland. The Bell has a 20-gal. P.V.C. chemical tank attached to each side of the central fuselage, and a 22-ft. plastic sprayboom mounted on the tips of its newly fitted skids.

To Speed the D.H.121

IN order to strengthen its design organization at Hatfield the de Havilland Aircraft Co. is centralizing the whole of its design team at the company's headquarters. At present, design work is divided between the company's Christchurch and Hatfield factories. The new arrangement has meant that about 100 members of the Christchurch staff, representing about half its design team there, have been asked to move to Hatfield, starting next September.

The reason for only part of the staff being transferred to begin with is that Sea Vixens for the Royal Navy are in production at Christchurch and de Havilland technical staff will still be needed there for modification design. These designers may, however, also be moved progressively to Hatfield when they are no longer needed for Sea Vixen work.

At the present time, the company is also advertising for design staff to work on the D.H.121 airliner which it is developing for B.E.A. It would thus appear that the Hatfield design group is to be increased considerably, no doubt because a concentrated effort will be necessary if the D.H.121 is to enter service by 1964. Plans call for this airliner to be developed more rapidly than contemporary British transports.

Open Day at Teddington

WITH their customary attention to detail, the staff of the Aerodynamics Division of the National Physical Laboratory set out some most informative displays of their work for the Laboratory's Open Days on May 27 and 28. Much of the work at present in progress is a continuation or extension of that seen last year, but there was a good deal on show that was new.

Most of this was concerned with the problems associated with high speeds and very thin highly-swept wings. This work is largely directed towards finding ways and means of reducing the drag increases arising from compressibility effects at the high cruising speeds envisaged for the future civil transports; the reduction in L/D ratio brought about by the presence of shock waves can have a serious adverse effect on the operating economy of such aircraft. A comprehensive programme of research into planform and section shape is being undertaken in the N.P.L.'s 25-in. by 20-in. and 36-in. by 14-in. wind-tunnels.

In essence the problem is to ensure that the constant-pressure lines across the wing under cruising conditions are straight and sufficiently swept themselves to keep the component of local speed normal to them less than the speed, in terms of Mach number, at which shock waves would appear on an unswept wing. This is the principle that is already applied to the wing design for present-generation aircraft.

If the sweepback is increased beyond that adopted for the current transports a similar state of affairs could be made to exist in the case of the next-generation aircraft which will operate at low supersonic speeds. In this case, although there may not be any appreciable wing wave drag, there would be some wave drag coming from shock waves generated by the fuselage.

Research at N.P.L. in this field has shown that having obtained a suitable basic aerofoil section and wing planform, in order to achieve the full benefits of sweepback over the entire span the camber has to be modified and twist incorporated particularly near the root and tip. This has been found impossible to achieve near the root without "waisting" the fuselage; and although this can be accepted in military aircraft, one of the major problems for civil application is to reduce this encroachment into payload volume to a minimum.

A particularly interesting series of experiments being done in relation to high-speed wing configurations is concerned with an "M" wing planform. This is thought to offer a number of advantages over the conventional straight-swept wing but its aerodynamics is more complicated and less well understood. The N.P.L.'s work in this respect is directed towards providing information which will enable an accurate assessment to be made of such a wing.

For aircraft intended to cruise at Mach 2 or thereabouts there appears to be much to commend the slender delta. This planform, however, has cast up some aerodynamic problems which require fundamental investigation. For example, it has been found that there is an alternative flow régime in which instead of there being a smooth flow over the leading edge there is separation and the formation of a large-scale vortex. This could have consequent serious effects on stability characteristics.

At N.P.L. this supersonic-speed research includes comparisons between experimental and theoretical prediction for different thickness distribution on narrow deltas with rounded or sharp leading edges. The vortex flow is being studied and a preliminary qualitative study of the flow behaviour under dynamic conditions is being made. For this last-named the Laboratory have devised a remotely controlled probe for exploring the three-dimensional vortex flow.

All the work explained and demonstrated by Dr. Jones' staff has a bearing on likely future developments. For this reason alone, a visit to the N.P.L. on Open Day is always well worth while.

This year, however, the aerodynamically minded guests found that a link with the past had gone. The Laboratory's huge Duplex tunnel—dominant feature of the establishment for many years—has at last been demolished. It was always a reminder of the remarkable progress that has been made in aerodynamic knowledge and research in the past half-century.

NEW TWO-SEATER.—Latest of the two-seat high-speed operational trainers is the English Electric Lightning Trainer, powered by two Rolls-Royce Avons. Side-by-side seating for the two occupants has been achieved with a minimum modification to the fuselage, only the upper part of which has been locally widened.

Air Transport

BEA-TAP Agreement

AN operating agreement between B.E.A. and T.A.P. Portuguese Airways provides for the use of B.E.A. Viscounts, on charter, on all T.A.P. services between Lisbon and London. Effective from June 9, this arrangement will go some way towards solving T.A.P.'s recent equipment difficulties, and will leave the Portuguese airline's Super Constellations free for the Portuguese African services.

An immediate result is that a daily Viscount service will now be available, leaving London each morning and Lisbon each afternoon at the same time of day. Other advantages expected to follow between now and next spring are the introduction of night services and a "sharp reduction" in fares.

Boeing 707—A Progress Note

PRODUCTION of the Boeing 707 is now mounting rapidly towards its peak rate of nine aircraft a month. On May 26, the fiftieth production 707 was pushed out of the door at Renton, and thirty had been delivered before the end of the month. The first fifty aeroplanes comprise eight for Pan American (including two Intercontinentals), 14 for T.W.A., 17 for American Airlines, three for Continental, three for Qantas, one for B.O.A.C., one for Braniff and three for the U.S.A.F. The Renton plant has, in addition, delivered well over 250 KC-135 tanker-transports to the U.S.A.F.

In a spring, 1959, progress report, the Boeing Airplane Co. records that Pan American have flown more than 129,000 passengers in 707s since October, 1959; American Airlines have flown more than 72,000 passengers and T.W.A. have flown more than 30,000 passengers. T.W.A. has been achieving average load factors as high as 99.1% on transcontinental routes, and Pan American has achieved an average daily utilization of 8.0 hr., with its current utilization up to 9.0 hr. a day.

As recorded last week, certification of the Intercontinental model of the 707 is now more than half complete. The F.A.A. programme began on February 15, only 35 days after the 707-320 made its first flight, and has involved two JT-4A powered aeroplanes destined for Pan American. They have now been joined by a third Intercontinental, the first 707-436 for B.O.A.C. This made its first flight, from Renton to Seattle, on May 19, and was then being instrumented prior to the start of the flight and certification tests.

In keeping with previous Boeing practice, these Intercontinentals are very fully instrumented for test flying. Transistors are used to detect and measure strains on the structure; their readings, and those of the many other instruments on board, are continuously recorded on magnetic tape. This system, together with one photo-panel, provides a record of some three million readings on a two-hour flight, whereas—by comparison—the Vickers Vanguard is currently instrumented to provide some 15,000 recordings an hour.

Whilst the Boeing system—typical of current American practice—provides an abundance of data, its reduction to an understandable form requires complex equipment on the ground. The magnetic tape is "translated" on to I.B.M. punched cards, which, in turn, can be used to draw the curves of any required characteristic. For speedy results the tape record can be sampled at given intervals, leaving the gaps to be analysed later. It is also customary, on certain types of test flying, for readings to be telemetered to a ground station, so that the pilot can be informed of his success in completing the trials, or of any dangerous build-up of conditions, which might otherwise go undetected.

The Intercontinental models of the 707 are being certificated at an initial weight of 315,000 lb. (316,000 lb. at the ramp). This is 19,000 lb. above the weight originally guaranteed for the -320 and can be expected to increase still further as more powerful engines come along and design refinements are made. The JT-4A-3 engine used at present in the 707-320 series is rated at 15,800 lb., but a JT-4A-9 of 17,500 lb. is already offered for delivery in mid-1960. For later service, there is the 22,500-lb. JT-4D-3, a turbofan version using the front fan section already designed for the JT-3D-1 (J-57) and the 25,000-lb. JT-4D-1, a turbofan with specially designed front fan.

The Rolls-Royce Conway 505 (R.Co.10) in the Boeing 707-420 series already has a guaranteed minimum thrust of 16,500 lb. and a type-test rating of 17,000 lb., while the later Conway R.Co.12 and R.Co.14 have guaranteed minimum thrusts of 17,500 lb. and 18,500 lb. respectively.

At the lower end of the scale, the 16,000-lb. JT-3D-1 turbofan is being offered by Boeing in the 720B, available in 1961. The first 720 (for United) will be rolled out in October this year for service next year. Meanwhile, the old "dash-80" prototype of the 707 series, which has flown 1,200 hours in five years, is testing some 720 features. These include a new inboard wing leading-edge "glove" to reduce the effective t/c ratio, and full-span leading-edge flaps. With these modifications, the "dash-80" has reached a Mach number of 0.91.

Total announced orders for the 707 and 720 series now stand at 165, to which Boeing add 25 "firm but unannounced" orders for a grand total of 190.

B.O.A.C. BOEING.—B.O.A.C. hopes to have its Conway-engined Boeing 707-436s in service on the North Atlantic early next year. This picture shows the first take-off from Renton, on May 19.

Air Transport . . . .

The Air Union Traffic Quotas

IN last week's issue (page 640) we were not able to amplify the considerations behind the shares of the four European airline companies in the newly named Air Union. These shares, or quotas of traffic, are provisional estimates, and final figures will not be applied on a definite basis until traffic has reached a volume five times as great as that for 1958—a growth which may, in terms of ton-miles, involve an interim period of more than 10 years even at the present rates of progress.

The proportions are based on several factors—such as population, national income and external trade—which serve to explain the comparatively low percentage agreed by Sabena. The factors may also explain why K.L.M. dropped out of the talks—because, presumably, it could not agree to a traffic quota based on these or similar estimates when this airline has, through the years, depended to a great extent on its fifth freedom traffic.

The agreed traffic ratios, as recorded last week, and with the 1958 traffic percentages in brackets, are: Air France, 34% (50%); Lufthansa, 30% (17%); Alitalia, 26% (15%); and Sabena, 10% (18%). The ratios will include the domestic traffic of Lufthansa but not that of Air France and Alitalia; neither French nor Belgian traffic to and from or within Africa will be included, though Sabena's Belgian-Congo traffic will be brought into a pool system outside the quota.

The major aim of Air Union is, as already deduced, to strengthen the companies' position in competition with the World's large airlines and to co-ordinate and integrate all international services so that duplication will be avoided and good load factors ensured. It may be assumed that Air France and Sabena have been prepared to accept reduced shares, by present traffic standards, because of the increased overall business to be expected and of the economies made possible by the eventual pooling of engineering, commercial and other services.

J.A.L.—The Next Five Years

NOW that Japan Air Lines is well into its sixth year of long-haul operations, two major long-term plans are nearing reality. One is the introduction of turbojets on the Pacific runs and the other is the extension of the network to include a round-the-World turbojet service by 1963. An important, but less spectacular, development is likely to be the introduction of smaller, medium-haul turbojets on this operator's trunk domestic and south-east Asian routes.

The first of four 120-passenger, mixed-class Douglas DC-8s is due for delivery in May, 1960, and trans-Pacific services with this aircraft type will probably be started in July, 1960. In the following year DC-8s will be put on an Arctic route to London as the first part of a proposed round-the-World service which should be in operation, via London and New York, in 1963. A New York service via the West Coast should meanwhile have been inaugurated.

At present J.A.L. is operating daily trans-Pacific services to

PENINSULA RUNWAY.—Seen in typical conditions through a hole in the clouds, Hong Kong Airport's new 8,350-ft. "dredged hill" runway juts out from Kowloon, with the old Kai Tak runway system above it. In the foreground is Hong Kong island.

San Francisco via Honolulu and, as from last week, to Los Angeles. In July a service to Seattle will be opened, making nine services a week in all between Japan and the U.S. West Coast. Last year's average load factor on J.A.L.'s Pacific services was 66.5% and by last month the 100,000th passenger had been carried over this route. Pan American enjoys higher factors. With the help of a vigorous sales-promotion drive, J.A.L. hopes, with the DC-8s, to take advantage of a continuing backlog of Pacific bookings. Although the Government has a 75% holding in J.A.L., no subsidy is paid and J.A.L. has made a small profit every year since 1954.

Japan Air Lines present problem is that of deciding what, if anything, to do about re-equipment for the medium-haul international and trunk domestic services. B.O.A.C. is already offering turbojet competition with Comet 4s in the Far East areas and Qantas will be introducing Boeing 707-138s later this year. Air-India International's 707-437s, due early next year, are, like J.A.L.'s own DC-8s, essentially long-haul, big-capacity aircraft, and are not competitive in the same sense. It may well be that A.I.I. will need to buy smaller turbojets for much the same reason as those being considered by J.A.L., which is studying the Comet 4, the Convair 880 and the Boeing 720—as well, so we were told in Tokyo earlier this year, as the V.C.10 on a rather longer-term basis.

The difficulty is likely to be one of timing—in relation both to likely competition in the south-east Asian regions and to market values of existing fleet units. J.A.L.'s DC-6Bs, and those of other World operators, are likely to continue to be saleable at a fair price for many years to come, but the bigger long-haul DC-7Cs will steadily drop in value as more of the World's airlines put long-haul turbojets into service. The DC-4s now probably have little or no book value and will be sold as soon as DC-6Bs become available to replace them on the domestic routes.

South American Commentary

Market far from Brisk

BRAZIL is traditionally the place where everything is bigger, wider or longer than anywhere else, or so the Brazilians say. Thus it is typically Brazilian that one of Aerolíneas Argentinas' new Comet 4s should, while on one of its seemingly interminable training flights, have blasted almost 50 ft. of runway into oblivion at Aeropuerto Galeao, in Río de Janeiro. This was during take-off; the efflux from the four jets melted away the surface composition and ensured that not even a DC-3 could use that portion of runway—and, as everybody knows, that's saying something.

Anyhow, we presume Rolls-Royce and D.H. officials didn't know whether to look happy or sad when they heard the news. Was this merely a bit of nastiness between one aircraft and another over the recently announced Aerolíneas jet differential? We ask this because the Comet's Welsh rarebit *à la Brésilienne* effectively prevented the landing, a few hours later, of the Bristol Britannia carrying Dr. Fidel Castro, the Cuban Prime Minister.

Or it might have been an Anything You Can Do I Can Do Better tiff between Bristol and Rolls-Royce, because the very first aircraft to chew up Galeao's runway was yet another Britannia, this time carrying the Duchess of Kent and Princess Alexandra. If things go on at this rate the criterion of whether or not an aircraft has adequate take-off power will be represented as a function of X—X being established as one metre of Galeao runway melted into *pâté de foie*.

However, in spite of money shortages—most of the funds available in Brazil today seem to be going towards building Brasilia—at least one of the Brazilian carriers (national and international) is girding its loins for the jet age. Varig, one of the largest airlines in South America, plan to start experimental Caravelle flights in late 1959 and scheduled services around the New Year. Varig technicians are already learning the ropes in the Sud-Aviation factory prior to delivery of the first aircraft.

Up to now the Brazilian airlines had not been in any special hurry to buy jets because of airport inadequacies. In time they will probably all see the light and go over to jets, but they are having a lot of trouble with seat load-factors right now, and money is in very short supply. As in Argentina, where fares have risen steeply and bookings have dropped almost in geometrical inversion, flying has unfortunately once more returned to the luxury class and only the rich or the expense-sheeted can go by air. The airlines have seen their costs rise day by day and have had to put up fares in self-defence, but the buying public have not responded. The Brazilians have notched down their fares by 20%, but this isn't a very good prospect for equipment renewal, is it now?

Canadair, the Canadian division of General Dynamics, have been showing a Canadair Eland 540 around the capitals of South America. They put on a strong show in Buenos Aires, where rumblings are getting louder and louder to the extent that maybe the Government won't be too keen to lay all those *pesos* on the line, after all, for the loudly acclaimed purchase of 10 to 15 F-27 Fairchild Friendships by Aerolíneas Argentinas, the State-operated domestic and international airline. Fairchild representatives in Buenos Aires recently held a cocktail party. They said that their parent company had been successful in obtaining a credit for the F-27 operation (deferred terms were demanded by the Aerolíneas men when the deal was being negotiated), but that, unless the sale went through within a certain time, the credit was cancelled. This, they intimated, would be a tragedy for the Argentine people.

One must report that the Argentine people faced the possibility with a stoic calm, however. Considered on a direct *panem et circenses* relationship, popular opinion seems to group new aircraft in the circus category rather than in the daily-bread classification. All these remarks were at times drowned out by the whine of the 540's two Elands passing overhead (actually they weren't, but it's a beautiful metaphor, isn't it?) but it doesn't seem that Canadair will have any more luck than Fairchild. No one can yet say that the purchase of the F-27s is off, but the signs and portents point that way.

Meanwhile Boeing have been flying their big 707s up and down South America on training flights and also, of course, to show the flag. They have done New York—Carácas (Venezuela) in 4 hr. 23 min. against a normal 7 hr., and Paramaribo (Dutch Guiana) to Asunción in 4 hr. 7 min. (No comparisons are available in regard to the latter figure, because up to now nobody in Paramaribo had shown any interest in going to Asunción, or vice versa.) They reckon to fly Buenos Aires—New York in 12 hr. 6 min., slightly faster than the Aerolíneas Comets. No doubt the battle, once waged, will be intense. Of course, PanAm will have to buck a lot of chauvinism or protectionism in South America before spreading its jet wings all over the Continent.

Meanwhile South American carriers are, as always, biting at each other and constantly plotting to block each other's path to more flight frequencies. All the airlines want to increase their own frequencies but raise howls of protest when another line tries to do the same. For illustration's sake, however, we append a table of seat load-factors and passengers-per-aircraft between Europe and South America for the main carriers (except Aerolíneas Argentinas):—

Airline	Seat load-factor (%)	Seats filled per aircraft
Air France	60.75	33.88
Alitalia	56.91	29.05
Iberia	36.05	23.67
K.L.M.	46.95	26.73
Lufthansa	50.08	28.31
Panair do Brasil	44.78	26.07
S.A.S.	48.55	27.91
Swissair	60.43	33.39

The old story about "more frequencies, higher seat load-factor" is pretty well borne out by Air France, Lufthansa and Alitalia, who operate a three-cornered agreement on the South American run, offering complete ticket interchangeability, without need of endorsement, between the three lines (Alitalia fly DC-6Bs, the others L-1049Hs). Another line with a high factor is Swissair. They fly "by themselves" but seem to have managed to gain the confidence of the intercontinentally commuting public.

We were going to make some crack about that residual 0.39 passenger and whether he got 0.39 IATA sandwiches—but it just isn't worth it.—FEDERICO B. KIRBUS.

Air Transport . . . .

A New Helicopter for Commercial Service

ONE of the exhibits likely to occasion particular interest at the Paris Aero Show is the Vertol 107 twin-turbine helicopter. Powered by two 850 s.h.p. Lycoming T53 shaft-driving turbines, the Vertol 107 prototype was built as a private venture to meet the anticipated needs of the U.S. military forces for a mobility support helicopter, having secondary applications in the commercial field. Orders have already been placed for developed versions by the U.S. Army (the YHC-1A and -1B Chinook) and civil operators including B.E.A. and N.Y.A. have been closely studying the commercial possibilities of the type.

Development of the Vertol 107 has been remarkably rapid. The decision to proceed with construction of a prototype was taken by the company on May 28, 1957, and the completed airframe was making its first runs in the tie-down rig by April 7, 1958. The first hovering flight was made on April 22, followed by the first forward flight on April 25. Since then the prototype has been extensively flight tested and has been giving demonstrations to military and civil authorities. The visit to Paris is the first overseas demonstration.

The Vertol 107 has a tandem rotor layout, but the two engines are located side-by-side in the base of the aft pylon. Both engines feed into the mixing gearbox, behind, and from this gearbox are taken the aft and main rotor shafts. Although this arrangement requires a shaft running the length of the cabin to drive the front rotor, it provides greater flexibility of power plant installation, and Vertol have already projected versions with three Lycoming T53s in place of the two T58s at present standard. Another "growth" version has Lycoming T55s.

VERTOL 107
(Production version—provisional data)

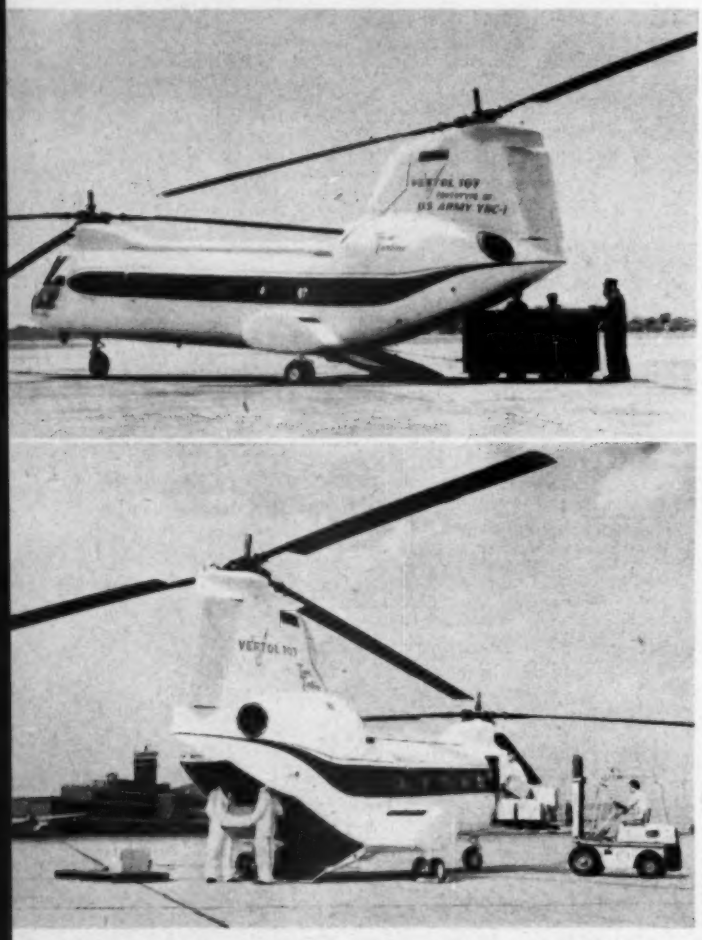
Dimensions
- Rotor diameter: 50 ft. 0 in. each
- Overall length (excluding rotors): 44 ft. 7 in.
- Overall height: 18 ft. 0 in.
- Disc area (each rotor): 1,995 sq. ft.
- Internal cabin dimensions:
  - Length (ex. flight deck): 24 ft. 2 in.
  - Max. width: 79 in.
  - Max. height: 72 in.
  - Max. usable floor area (ex. flight deck): 145 sq. ft.
  - Max. usable volume (ex. flight deck): 935 cu. ft.

Accommodation
- Normal tourist: 23 (3 abreast)
- Max. coach: 30 (3 abreast)
- Volume of baggage hold: 95 cu. ft.

Powerplants
- Two General Electric T58-8 shaft turbines
- Take-off power each (I.S.A., s.l.): 1,450 s.h.p.

Weights and Loadings
- Basic operational: 11,246 lb.
- Total fuel: 2,754 lb.
- Mfrs. max. payload: 6,640 lb.
- Max. gross: 18,400 lb.
- Gross weight for engine-out climb of 150 ft./min.: 18,400 lb.

Performance
- Typical cruising speed I.S.A.+10°C, 1,000 ft.): 135 knots.
- Minimum flying speed, engine-out: 35 knots.
- Speed for best climb: 75 knots.
- Range, no reserves, (I.S.A.+10°C, 1,000 ft.): 340 naut. miles.



VTOL FREIGHTER.—Loading capability of the Vertol 107 is shown in these pictures. Above, a military load is being winched into the fuselage. Below, goods are being loaded manually through the rear hatch while a conveyancer is serving the forward loading hatch.

Three-bladed, fully articulated, partially overlapping rotors are used, synchronized by positive gearing. They are interchangeable and designed for an initial life of 2,500 hours. Rotor construction is based on a seamless steel spar leading edge with a series of aluminium alloy boxes attached to the spar to form the trailing edge.

The cabin has a constant cross section from the cockpit bulkhead to the rear pylon, and the main passenger door is forward on the starboard side, with integral steps. Accommodation can vary up to a maximum of 30 in a high-density "sky-bus" lay-out. For normal airline operation the cabin would accommodate 23 passengers, in single and double seats at 34-in. pitch; this arrangement leaves space for a toilet and galley if required.

The all-metal, semi-monocoque fuselage is built as a watertight hull, with sealed compartments under the cabin floor. This provides adequate buoyancy for emergency landings in calm water, with lateral stability provided by the stub wings into which the landing gear retracts. For extra buoyancy, small flotation bags can be attached to the stubs.

Provision is made for two-crew operation. A particular feature of the Vertol 107 is its all-weather operating capability, for which the basic equipment is SAS (stability augmentation system). The SAS is a simple, lightweight device which senses change of altitude and feeds a corrective input to the corresponding flight control actuator, which then makes a control correction in the rotor heads, differentially, without moving the pilot's controls. The pilot has manual over-ride at all times.

The Vertol 107 has dual SAS, the back-up system being electronic; either can maintain stability. It is also possible to incorporate automatic stabilization equipment (ASE) into dual SAS, by adding the electronic components of the ASE. The ASE functions as a true autopilot, able to control the flight path accurately, and can be coupled with Doppler, ILS or other navigational aids for automatic flight and landing.

For all-weather operation, thermo-electrical rotor blade de-icing is available.

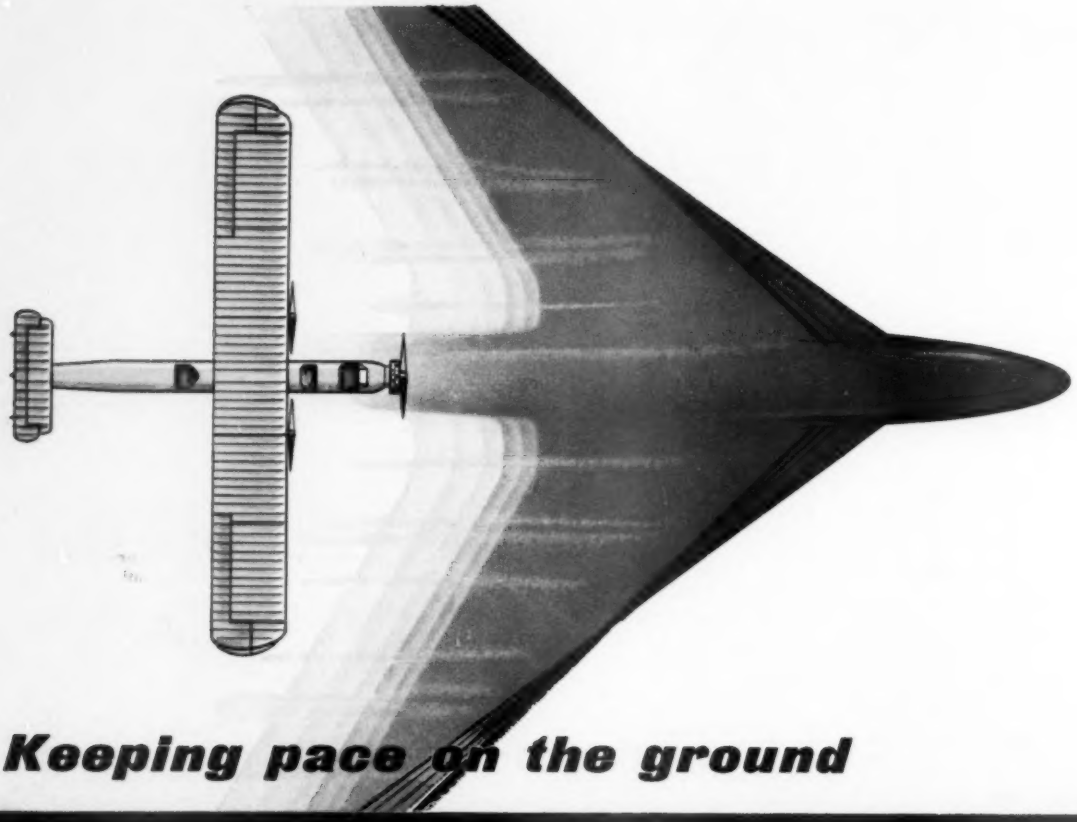
Particular attention has been paid in the detail design of the Vertol 107 to facilitating maintenance and inspection work. For example, built-in work platforms are located at each rotor hub position and there are two walkways along the crown of the fuselage. By this means all the major blade and hub components are within easy reach.

Ready accessibility is provided by using quick-release flush-type fasteners on all hinged access panels and cowlings. Control cables, transmission shafting, electrical cables and hydraulic fluid lines are all located in the main drive shaft duct along the top of the fuselage; and all can be reached from the outside of the fuselage.

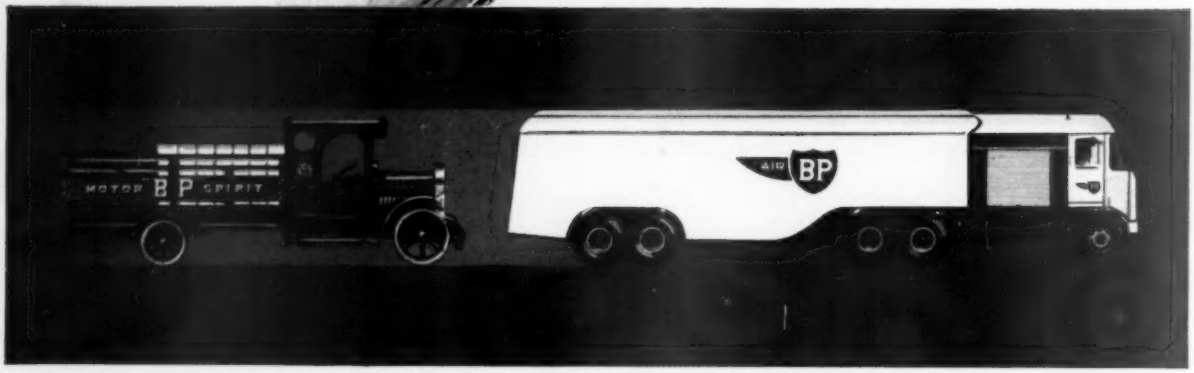
"THE SEASLUG ...IS THE BEST THING THE NAVY HAS EVER HAD"

This was the opinion of the officer commanding H.M.S. Girdle Ness, the Royal Navy's guided weapons trials ship, after extensive trials in the Mediterranean. He was commenting on Britain's first ship-to-air missile and he added: "It is extremely accurate–a most excellent and necessary addition to the Fleet armoury". Since 1956 extensive trials have been carried out on every part of the Seaslug system aboard H.M.S. Girdle Ness. Many missiles have been fired, scoring direct hits on target aircraft–though the Seaslug, which can engage bombers at maximum ceiling, need not score a hit to destroy its objective. Both the missile and the shipborne equipment passed the rigorous tests with flying colours.
The Seaslug is due to be fitted into four ships of the new County class. It has been designed and constructed by A.W.A. in collaboration with Sperry Gyroscope Co., Ltd., and The General Electric Co., Ltd.

SIR W. G. ARMSTRONG WHITWORTH AIRCRAFT LTD.
Baginton, Coventry.
MEMBER OF HAWKER SIDDELEY AVIATION DIVISION



Keeping pace on the ground



with progress in the air . . .

In the air phenomenal advances have been made in a brief span of time. Speeds have increased enormously. Continents are now overflown non-stop. Each year the volume of air traffic grows greater. Such progress has been possible only because essential services have kept pace on the ground. In the not-so-distant past when BP began fuelling operations, it sufficed to use 2-gallon cans man-handled from an open lorry. Now the latest airliners require 20,000 gallons a 'hop', to be delivered — because of ever swifter turn-rounds — in less than 20 minutes.

By unceasing research and technical development AIR BP, the pioneer of turbine fuelling, is prepared for this challenge. Its latest 10,000-gallon super-fuellers deliver at 750 gallons a minute; its hydrant systems carry fuel underground right to the aircraft at even higher flow rates. With a new range of lubricants and special products, improved methods of filtration, a complex ground organisation to support aviation AIR BP is poised today for even greater achievements.

AIR BP

THE AVIATION SERVICE OF BRITISH PETROLEUM

At the Paris Salon . . . .

British Aircraft on Show

ARMSTRONG WHITWORTH ARGOSY.—Appearing for the first time in a public demonstration, the Argosy (four 2,100 e.h.p. Rolls-Royce Dart 526 turboprops) will provide one of the highlights at Paris, where it will be displayed all the week. The Argosy on show is in fact the fourth of a pre-production batch of ten; all four aircraft have flown this year—respectively on January 8, March 14, April 26 and May 13. By the time this issue appears, they are expected to have totalled some 220 hrs. in the air. Riddle Airlines, a U.S. freight operator, has ordered four Argosies, and Riddle markings are carried on the example in Paris, which will later be used for world-wide demonstration tours. Cargon loading, and the A.W.A-developed roller conveyor palletized system of loading, will be demonstrated on the ground. A model of the A.W.660, as ordered by the R.A.F., will be on the Hawker Siddeley stand. Span, 115 ft. Length, 86 ft. 9 in. Gross weight, 82,000 lb. Cruising speed, 263 knots. Range (no reserves) with max. 28,000 lb. payload, 620 naut. miles.

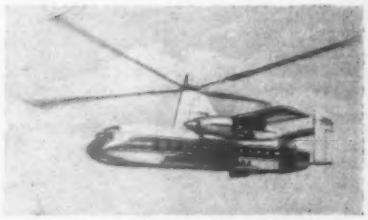
AVRO 748.—A model of this new Dart-engined feeder-liner, scheduled to make its first flight next February, will be on show for the first time. The 1/12th scale model is fully sectioned to show a typical interior layout, and display panels will stress the chief features of the new 36-44-seat design, including its low operating costs, simplicity of servicing, fail-safe structure and good airfield performance. Span, 95 ft. Length, 67 ft. Gross weight, 33,000 lb. Cruising speed, 230 knots. Range (no reserves) with max. 11,000 lb. payload, 580 naut. miles.

AVRO SHACKLETON 3.—A 1/12th scale model shows the latest mark of this well-known maritime reconnaissance aircraft (four 2,450 h.p. Rolls-Royce Griffon engines) in service with the R.A.F. and South African Air Force. Span, 119 ft. 10 in. Length, 92 ft. 6 in. Gross weight, 100,000 lb. Cruising speed, 253 m.p.h. Typical range, 3,660 miles at 1,500 ft.

AVRO VULCAN.—A Vulcan B.1 (four 13,000 lb.s.t. Bristol Siddeley Olympus 104 turbojets) will be flown in the displays next week-end by the R.A.F. On the Hawker Siddeley stand, Avro will display a 1/12th scale model of the Vulcan B.2, complete with the Avro stand-off bomb. Now in production, the B.2 has a modified wing of greater span, and 17,000 lb.s.t. Olympus 201 engines. Span, 111 ft. Length, 97 ft. 1 in.

BLACKBURN N.A.39.—Taking advantage of a recent security down-grading, Blackburn Aircraft will have an N.A.39 naval low-level strike fighter (two de Havilland Gyron Junior turbojets) in the static exhibition next week-end, providing the first opportunity to inspect this impressive aircraft at close quarters. Points of interest are the arrangements for flap blowing on the wing and tailplane, the method of weapon-stowage in the bomb-bay, the "waisted" fuselage and the air-brake behind the tail. Blackburns flew five N.A.39s in twelve months from the first flight date, and are proceeding rapidly with completion of the pre-production batch of 20. Span, 42 ft. 6 in. Length, 62 ft. 4 in.

BRISTOL BRITANNIA.—Two examples of R.A.F. Britannias will be shown during the week. On June 17, the R.A.F. will display one of its Britannia 252s in the aero-medical rôle, and on June 20, Bristol will provide a Britannia C.Mk.1 (four 4,445 h.p. Bristol



Models of three new British aircraft on show at Paris are, above, the Tyne-engined Fairey Rotodyne; left, the Avro 748, and, below, the Short Britannic.

Siddeley Proteus 255 turboprops) for static and flying demonstrations. R.A.F. Britannias, which are just coming into service with No. 99 Squadron at Lyneham, have not previously taken part in public exhibitions. Span, 142 ft. 3 in. Length, 124 ft. 3 in. Gross weight, 180,000 lb. Max payload, 34,450 lb. Cruising speed, 346 knots. Max. range, 5,560 naut. miles.

BRISTOL 192.—Largest helicopter ordered for the R.A.F., the Bristol 192 will participate in the special helicopter demonstrations on June 18. Designed to meet Service troop and freight transport requirements for search and rescue, ambulance, paratrooping and supply dropping, the Type 192 (two 1,300 s.h.p.

Three of the first four Armstrong Whitworth Argosies are seen together here. On the left is one in Riddle markings, as shown in Paris.

At the Paris Salon . . . .

Napier Gazelle turbines) can carry 25 fully armed troops or 12 stretcher cases and two "sitting wounded." Rotor diameter, 48 ft. 8 in. each. Length, 89 ft. 9¼ in. Gross weight, 18,000 lb. Max. payload, 6,000 lb. Cruising speed, 120 knots. Max. range, 450 naut. miles.

ENGLISH ELECTRIC LIGHTNING.—One of the pre-production batch of Lightnings will take part in the flying displays next week-end, but will not be shown in the static park. The Lightning (two 17,250-lb.s.t. Rolls-Royce Avon R.A.24R turbojets) will be carrying two de Havilland Firestreaks. A special display model on the company's stand shows a typical interception flight path for the Lightning. Span, 34 ft. 10 in. Length, 50 ft.

FAIREY GANNET A.E.W.3.—A model on the Fairey stand shows the Gannet in its A.E.W.3 version (one 3,875-e.h.p. Bristol Siddeley Double Mamba 102 turboprop). This is the only version of the Gannet now in production; one of the early production models has recently completed deck-landing trials on H.M.S. "Victorious." Span, 54 ft. 4 in. Length, 44 ft.

FAIREY ROTODYNE.—The prototype Rotodyne (two Napier Eland turbines) will be flying to Paris to participate in the helicopter events on June 18, and will then remain for the final week-end. This will be the first appearance of the Rotodyne outside Britain. On the Fairey stand, a model of the enlarged, Tyne-engined Rotodyne will show the 65-passenger version for which New York Airways recently placed an order and which B.E.A. will probably order eventually. This version will have a rotor diameter of 104 ft., span of 56 ft. 6 in. and fuselage length of 64 ft. 6 in. Gross weight, 50,000 lb. Cruising speed, over 175 knots. Range with 18,000 lb. payload, 105 naut. miles.

FOLLAND GNAT. — Quarter-scale models on the Folland stand show the Gnat 1 light fighter and the Gnat Trainer (Bristol Siddeley Orpheus turbojet), 14 of which have been ordered for evaluation by the R.A.F. Smaller models illustrate the various tactical rôles of the Gnat. Span, 22 ft. 2 in. Length, 29 ft. 9 in. Gross weight, 6,575 lb. Max. speed, 603 knots at 20,000 ft. Typical range, 800 naut. miles.

GLOSTER JAVELIN.—The R.A.F. is to have a standard Firestreak-equipped Javelin FAW.7 (two 11,000-lb.s.t. Bristol Siddeley Sapphire 200-series turbojets) on permanent exhibition in the static park, representing the current all-weather equipment of Fighter Command. Gloster Aircraft Co. now have in hand a programme to install the 12,300-lb.s.t. re-heat versions of the Sapphire in Javelin 7s which, with other equipment changes, will then be designated FAW.9s. The Javelin FAW.8, also with re-heat engines, has different radar equipment. Span, 52 ft. 0 in. Length, 56 ft. 9 in.

The Bristol 192 tandem-rotor helicopter, in production for the R.A.F., will be demonstrated on June 18.

HANDLEY PAGE VICTOR B.1.—A standard squadron Victor (four Bristol Siddeley Sapphire 200-series turbojets) will be provided in the flying display by the R.A.F. Handley Page, Ltd., are now producing the Victor B.2, with greater span and Rolls-Royce Conway R.Co.11 turbojets. Span, 120 ft. 0 in. Length, 114 ft. 11 in.

HAWKER HUNTER.—The R.A.F. expects to provide a Hunter T.7 two-seat trainer (one 7,600-lb.s.t. Rolls-Royce Avon 122 turbojet) for static display throughout the week. In addition, No. 111 Squadron, with Hunter 6s, will participate in the flying displays on June 20-21. On the Hawker Siddeley stand, a special display shows models of the Hunter in the insignia of all the different Air Forces with which it serves. Mk. 7 data: Span, 33 ft. 8 in. Length, 48 ft. 10½ in. Gross weight, 21,700 lb. Max. speed, Mach 0.92 at 36,000 ft. Time to 40,000 ft., 9.5 minutes. Range (two 100-gallon drop tanks), 800 naut. miles.

HUNTING JET PROVOST T.3.—One of the R.A.F.'s new primary jet trainers (one 1,750-lb.s.t. Bristol Siddeley Viper 102 turbojet) will be on static display during the week. The Jet Provost is in production for the R.A.F. and the Royal Ceylon Air Force, and is being evaluated by the R.A.A.F. Span, 36 ft. 11 in. Length, 32 ft. 5 in. Gross weight, 7,092 lb. Max. speed, 326 m.p.h. Max. range 565 miles.

SCOTTISH AVIATION TWIN PIONEER.—At the time of writing, it is expected that the R.A.F. will be showing one of these well-known STOL aircraft, in military guise, for at least part of the week. On the Scottish Aviation stand, details will be available of the new Series III Twin Pioneer with long-stroke Leonides 531/8 engines, which give an all-round improvement in performance. Demonstration tours with a Series III are expected to begin next month. Span, 76 ft. 6 in. Length, 45 ft. 3 in. Gross weight, 14,600 lb. Cruising speed, 114 knots. Range with 2,300 lb. payload, 695 naut. miles.

SHORT BRITANNIC.—On the Short Bros. and Harland stand, a model indicates the general appearance of the S.C.5 Britannic, the strategic transport recently ordered by the R.A.F. Based on the Britannia wing, the Britannic features four Rolls-Royce Tyne engines and a new fuselage design with a 12-ft. by 12-ft. interior cross-section and a rear loading ramp. The first Britannics are scheduled for delivery to the R.A.F. in 1962, and commercial versions can be available in 1964. Span, 148 ft. 3½ in. Length, 134 ft. Gross weight, 195,000 lb. Max. payload, 75,000 lb. Cruising speed, 310 knots. Max. range, 4,750 naut. miles.

SHORT S.C.1.—Representing Britain's VTOL research programme, a model of the S.C.1 (five Rolls-Royce R.B. 108 turbojets) is shown by Short Bros. and Harland. This small delta-wing aeroplane has completed conventional flight trials and has made a number of free vertical take-offs. Transition from hovering to forward flight and back to hovering will be tested in the near future, marking the final phase of the development programme. Span, 24 ft. 5 in. Length, 23 ft. 6 in.

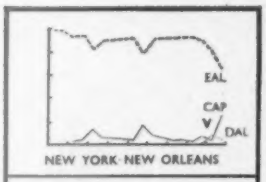
VICKERS VALIANT. — A Valiant will take part in the R.A.F. demonstrations next week-end. No longer in production, the Valiant (four Rolls-Royce Avon 204 turbojets) serves in the bomber, reconnaissance and tanker rôles and is being used for stand-off bomb development. Span, 114 ft. 4 in.; length, 108 ft. 3 in.

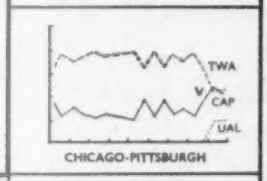
VICKERS VANGUARD. — Another new British transport making its first display appearance, the Vanguard (four Rolls-Royce Tyne 506), was to be seen at Paris on June 11, during the Press preview, and again next week-end. Two Vanguards are now flying, and have totalled nearly 200 hr. in the air since the programme began on January 20 this year. Visits have already been made to Hamburg, Brussels and Rome during development flying for the C. of A. Four aircraft (the third is about to fly) will take part in the 1,300-hr. programme with a target certification date of March 1, 1960. B.E.A.

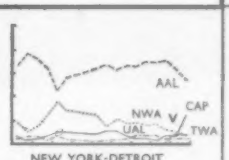
(*Continued on page 671*)

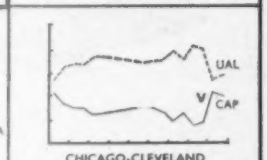
The Blackburn NA.39 naval strike fighter will be making its first public appearance in a static display next week-end, and will also be demonstrated in the air.

Operational success clinches the argument for the VISCOUNT









Competitive impact of Viscount 700 a vital factor in Capital's resurgence

V=Viscount Upsurge

A recent article in the American "Journal of Air Law and Commerce" (from which the adjoining graphs are reproduced), draws attention to the upsurge of Capital Airline's share of traffic following their introduction of Viscount services. The article continues, "The increase in Capital's share . . . is by no means a simple result of CAB policy. A closer look at Capital's traffic indicates that the competitive impact of the Vickers Viscount was also a vital factor. The remarkable upsurge of Capital in the 1956 section of each of these graphs follows the initiation of Viscount service. The Chicago-Washington route effectively exemplifies Capital's revival in 1955 with the initiation of Viscount services. By March, 1957, this dominance had increased from 42 to 55 per cent, while American's share dropped to 17 per cent". (V indicates period of time the Viscount was first introduced.)

Now, the Viscount 810/40 offers operators even more profitable operation than earlier Viscounts. Payload, speed and range have all been substantially increased, without raising air mile costs, giving considerably greater earning power.

More impressive facts about the VISCOUNT 810

- **Take-off weight now 72,500 lb. (up 3,500 lb.).**
- **Landing weight, zero fuel weight and payload all increased by 2,000 lb.**
- **Maximum-payload range increased from 800 to over 1,200 miles.**
- 365 m.p.h. When re-engined with more powerful Darts, 400 m.p.h.
- Backed by Vickers/Rolls-Royce turbo-prop experience of over 300 Viscounts in service with 40 airlines.
- Viscount 810 is already in service with or on order for T.A.A., Ansett-ANA, Continental Air Lines, Hunting Clan, Lufthansa, Aer Lingus, South African Airways, Pakistan International Airlines, V.A.S.P., Airwork, Cubana, and Sudan Airways.

CUMBERBATCH TROPHY FOR T.A.A.

Trans-Australia Airlines has been awarded the prized Cumberbatch Trophy for safety and reliability in Air Transport after an investigation into operation lasting over four years.

VICKERS VISCOUNT 810/840

FOUR ROLLS-ROYCE DART TURBO-PROP ENGINES

VICKERS-ARMSTRONGS (AIRCRAFT) LIMITED WEYBRIDGE SURREY ENGLAND

TGA AT618

NEWEST MEMBER IN A FAMILY OF GREATS

The Canadair-Convair '540', by the application of turbine power, becomes the ultimate development of the widely used and approved Convair 240-340-440 series. The '540' is now on order and in full scale production, and is currently being demonstrated to airlines and business aircraft owners throughout North America.

6 MAJOR REASONS

why the '540' is the new challenger on short-to-medium routes!

1 DEFINITELY LOWER OPERATING COSTS

The standard 48-seat Canadair-Convair '540' offers **a direct operating cost of 1.4¢ per seat mile which comes down to 1.1¢ in the 58-seat configuration.** Over distances as short as 80 miles, its economy of operation matches even that of piston-engined aircraft.

2 GROWTH CAPACITY TO MEET GROWING ROUTE DENSITIES

The Canadair-Convair '540' has the built-in capability of growing with the increased traffic densities that are forecast for the years ahead. It can do this because its **seating capacity can be increased by 20% from 48 to 58 without weight or operating penalty.** All fuel for terminal-to-terminal operation could still be carried.

3 MATCHED-TO-TASK JET-PROP ENGINES

The Napier 3500 e.h.p. engines that power the Canadair-Convair '540' are **the only jet-props specifically designed for the particularly strenuous up-and-down life of short stage operations.** The sectionalized design of these powerful new engines make them singularly easy to service and maintain.

4 REDUCED EN-ROUTE GROUND TIME LOSSES

The Canadair-Convair '540' **eliminates numerous possible time delays at en-route stops:** passenger handling is expedited . . . time consuming engine warm-ups are unnecessary . . . as many as 6 route stops can be made without refuelling.

5 FASTER FLYING, QUICKER CLIMBING

Today's passengers want to **make time.** The Canadair-Convair '540' is **the fastest aircraft in its class,** flying at speeds up to 340 m.p.h. It's off the ground in a flash and takes only 6.4 minutes to climb to an operating level of 10,000 feet.

6 EXTRA CARGO SPACE FOR EXTRA PROFITS

The Canadair-Convair '540' has 402 cubic feet of easily accessible cargo space: enough for **two tons of additional payload that** can be carried with no operating penalty.

MOST IMPORTANT TO YOU: the Canadair-Convair '540' is a product of the combined experience and facilities of two of the world's great aircraft producers—Canadair Limited of Canada and Convair—both members of the General Dynamics family of companies.

THE CANADAIR-CONVAIR '540' WILL SOON TOUR EUROPE

For full information about the new aircraft or the tour, please contact our European Representative, J. H. Davis, Princes House, 190 Piccadilly, London, W. 1, England.

CANADAIR CONVAIR 540

JET-PROP AIRLINER

CANADAIR, MONTREAL, CANADA

THE CANADIAN SUBSIDIARY OF GENERAL DYNAMICS CORPORATION CA59-540-22UKT

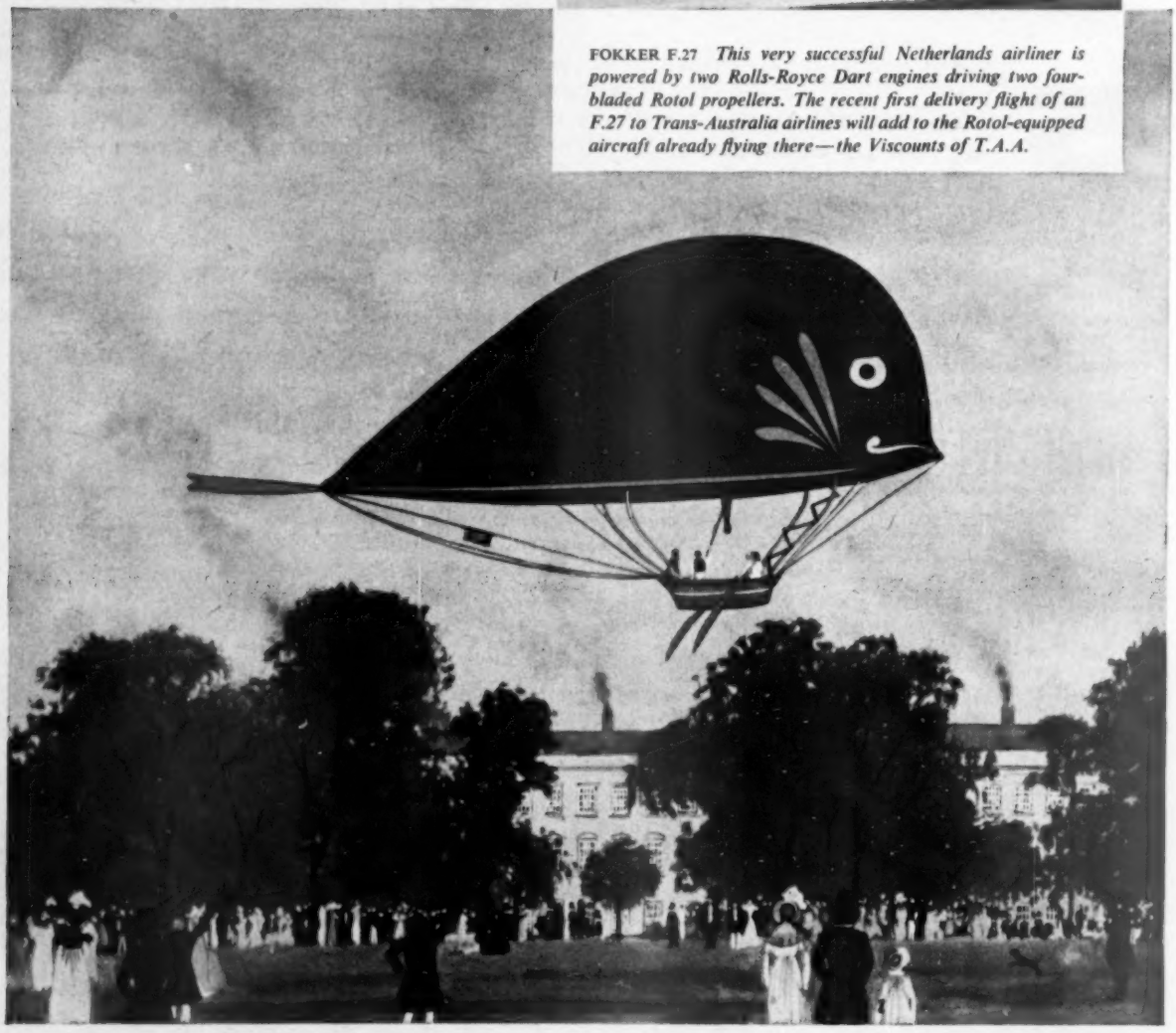
Propulsion through the ages...

A charming Regency folly

Among the many designs for dirigible airships which appeared between the invention of the balloon in 1783 and the arrival of the first practical airship in 1852, the most delightful was the DOLPHIN, designed by Pauly & Egg in 1816-17. Apart from the absurd "oar" propellers, it was to have had an interior balloonet to preserve its shape, and a device (visible here) to alter the trim by means of a moveable weight. Such ingenuity surely deserved success—but alas, the triumphal flight shown here took place only in the artist's imagination.

From near-fantasy to historical fact: Rotol were the pioneers of the turbo-prop, for they designed and built the propellers for the first turbo-prop aircraft to fly—and today over 100 airline and aircraft operators fly machines with Rotol propellers.

FOKKER F.27 *This very successful Netherlands airliner is powered by two Rolls-Royce Dart engines driving two four-bladed Rotol propellers. The recent first delivery flight of an F.27 to Trans-Australia airlines will add to the Rotol-equipped aircraft already flying there—the Viscounts of T.A.A.*



ROTOL ROTOL LIMITED · GLOUCESTER · ENGLAND

A Member of the Dowty Group

vr/2

At the Paris Salon . . . .

(*Continued from page 670*)

and T.C.A. have each ordered 20 Vanguards. Span, 118 ft. Length, 122 ft. 10½ in. Gross weight, 141,000 lb. Cruising speed, 367 knots. Range with max. 29,000-lb. payload, 2,540 naut. miles.

WESTLAND WHIRLWIND. — On June 18, the Gnome-engined Whirlwind will make its first public appearance. This is a standard Whirlwind, as produced in large numbers for the Royal Navy, R.A.F., Army and civil operators at home and abroad, but fitted experimentally with a 1,000 s.h.p. de Havilland Gnome shaft turbine. Rotor diameter 53 ft., fuselage length, 42 ft.

WESTLAND WESSEX.—An example of the Wessex (one 1,450 s.h.p. Napier Gazelle shaft turbine) now in production for anti-submarine duties with the Royal Navy,, will fly across to Paris in order to participate in the helicopter demonstration on June 18 and will give individual displays the following day before returning to England. Rotor diameter 56 ft., overall length 65 ft. 9 in., gross weight 12,600 lb., cruising speed 110 knots, max. range 340 naut. miles.

This Westland Whirlwind test bed for the de Havilland Gnome turbine will demonstrate its lively performance on June 18.

WESTLAND WIDGEON.—Throughout the week, the Westland Widgeon (one 515 h.p. Alvis Leonides 521/2) will be present, this being the junior model in the range of Westland helicopters. It is offered as a five-seat general-purpose transport, as an air ambulance or for specialized duties such as "sky-shouting," mineralogical surveys and so on. Rotor diameter 49 ft. 2 in., fuselage length 41 ft. 2¾ in., gross weight 5,900 lb., cruising speed 88 knots, range 260 naut. miles.

WESTLAND WESTMINSTER Series 1.—Completing the Westland quartet, the Westminster will participate in the displays on June 18, when it will demonstrate its lifting capability. The Westminster, first flown in June last year, has been making steady progress and has been lifting various special loads of up to 4,000 lb. It will be seen with long-range fuel tanks, which give an endurance of two hours. Rotor diameter 72 ft., overall length 89 ft. 3 in., gross weight 36,000 lb., cruising speed 100 knots, max. range (normal fuel) 180 naut. miles.

Another British aeroplane making its public debut at Paris is the Vickers Vanguard turboprop airliner.

Missile Exhibits From Gt. Britain

Sir W. G. Armstrong Whitworth Aircraft, Ltd.

In collaboration with the Sperry Gyroscope Co., Ltd., and the General Electric Co., Ltd., Armstrong Whitworth is showing a Seaslug surface-to-air missile mounted in a ship-type double-barrel launcher. Sperry is responsible for the missile's control system and General Electric for its guidance. Both companies are also showing Seaslug components which they produce. A ¼-scale model Seaslug will also be exhibited on the Hawker Siddeley stand.

The Seaslug missile system has been adopted by the Royal Navy and will equip its "Hampshire"-class guided-missile destroyers.

Bristol Aircraft, Ltd.

A Bloodhound surface-to-air missile is being demonstrated in the guided weapons park together with ancillary equipment including a launcher, a limber, a loading trolley and a launch-control post. Handling demonstrations with this missile are being given by a team of R.A.F. personnel. There is a model of a Bloodhound launching site on the Bristol Aircraft stand and a film shows the missile in action against target aircraft.

Claimed to have a longer range than any other semi-active homing missile in the Western World, Bloodhound is powered by two Bristol Siddeley Thor ramjet engines. The missile has been developed jointly by Bristol Aircraft, Ltd., and Ferranti, Ltd.

It is already in service with the Royal Air Force and a more advanced version is under development. The Bloodhound system has also been ordered by the Royal Swedish Air Board.

de Havilland Propellers, Ltd.

This company is exhibiting a Firestreak infra-red-guided air-to-air missile. Firestreak is in service with the R.A.F. and the Royal Navy; it will form the basic armament of the Gloster Javelin, the English Electric Lightning and the de Havilland Sea Vixen. A more advanced version of Firestreak is at present under development.

De Havilland Propellers is also responsible for the development of the Blue Streak LRBM, although its work in this field cannot be shown at Paris. Blue Streak is important both as Britain's first long-range ballistic missile and as a potential launching vehicle for Earth satellites. In this last context Blue Streak has been mentioned as the possible first stage of a three-stage vehicle. The second stage might be a modified Black Knight and the third, a solid rocket.

English Electric Aviation, Ltd.

A Mk. 1 Thunderbird and its launcher are on show in the guided weapons park; handling demonstrations with them are to be given by a British Army team. On the English Electric stand are ¼-scale models of Thunderbird on its launcher and a launcher-loading vehicle.

A display shows how missiles and aircraft—Thunderbirds and Lightning interceptors—can be combined with Marconi radar to form an integrated air-defence system.

The Thunderbird missile system has been designed for full mobility so that it can move with the Army in the field to protect it from enemy air attack and reconnaissance aircraft. It will enter operational service with the British Army next year; training has already begun. A more advanced version of the missile is being developed. This is said to have a greater range and a guidance system less vulnerable to counter-measures than that of the earlier version.

Fairey Aviation, Ltd.

In the static exhibition the Fairey company is showing a Jindivik Mk. 2B target aircraft. This jet-propelled target drone is produced in Australia by the Government Aircraft Factories and is used for missile development at Woomera and also by the Royal Swedish Aircraft Board.

On the company's stand, displays show the use of the Jindivik and mention the anti-tank guided weapon which is being developed by Fairey for the British Army.

A. V. Roe and Co., Ltd.

Exhibited by Hawker Siddeley is a model of the Avro stand-off bomb, suspended beneath a model Vulcan B.2. This new rocket-propelled missile will be carried by Mk. 2 versions of the V-bombers to increase their striking power and to eliminate the need for the bombers to fly over heavily defended targets.

Short Brothers and Harland, Ltd.

An SX-A5 test vehicle is shown of the type used in development of the Short Seacat SAM. This new anti-aircraft missile is being produced for the Royal Navy and is designed to replace the 40-mm. Bofors gun. It will intercept aircraft which evade defensive fighters and longer-range surface-to-air missiles. As a private venture Short Bros. and Harland is also developing the Tigercat, a land-based version of the Seacat.

At the Paris Salon . . . .

British Powerplants Displayed

TWO years ago the powerplant exhibits as a whole formed one of the most dominant features of the entire inside display at the Paris Aero Show. This year, other things such as guided missiles may be considered to take pride of place; but the engines on show are none-the-less an important and significant part of the static exhibition. And in this, the contribution from the United Kingdom is a major one.

In point of fact, Britain's aero-engine industry is very well represented at Le Bourget—for every one of the companies engaged in this particular work is showing examples of its latest products. It is particularly interesting to note the comprehensive range of powerplants that is offered. They range from the very large turbojets with reheat giving thrusts in the 24,000-lb. (10,886-kg.) category to the smaller shaft turbine engines delivering 1,000 s.h.p. (1,014 c.v.); ramjets, rocket engines, and turbine auxiliary power units, are all included.

On the stand of **Alvis Ltd.** there will be four engines, three of which have been seen before—at Farnborough. The newcomer is the 550 Series Leonides for helicopter applications and intended for such craft as the Sycamore, Widgeon or Agusta Bell. This is a vertical shaft version of the new long-stroke Leonides and gives a maximum power of 625 b.h.p. (635 c.v.) for a one-hour period.

The 530 Series Leonides—or long-stroke engine for fixed-wing aircraft is also on show. This engine has been a logical development of the original 718.6-cu.-in. (11.78 l.) engine in response to requests from airframe designers and from operators for more power. By increasing the stroke of the standard engine to give a capacity of 783 cu. in. (12.8 l.) the extra power was produced without any further complications in modified external geometry.

Also displayed at Paris are the two versions of the 14-cylinder twin-row Leonides Major for helicopter and fixed-wing applications. For the former the engine is known as the Type 755 and used, for example, in the Westland Whirlwind. In this form the engine has a maximum 1-hr. power rating of 795 b.h.p.

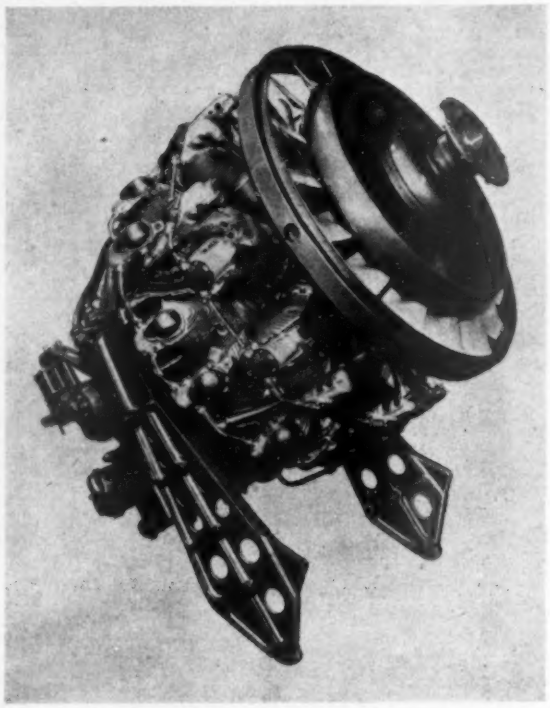
The horizontal-shaft Leonides Major for fixed-wing aircraft is basically the same powerplant but in this form it delivers a maximum power of 875 b.h.p. at sea level for take-off. The engine is supercharged to give a cruising power of 500 b.h.p. at 11,000 ft. (3,353 m.) and 2,600 r.p.m.—the corresponding power for the vertical-shaft helicopter engine being 580 b.h.p. at 2,800 r.p.m.

Blackburn and General Aircraft are showing three distinct types of powerplants—their shaft turbines, gas-turbine starter units, and airborne auxiliary power units. Representing the first category are the Turmo 600 and the A.129.

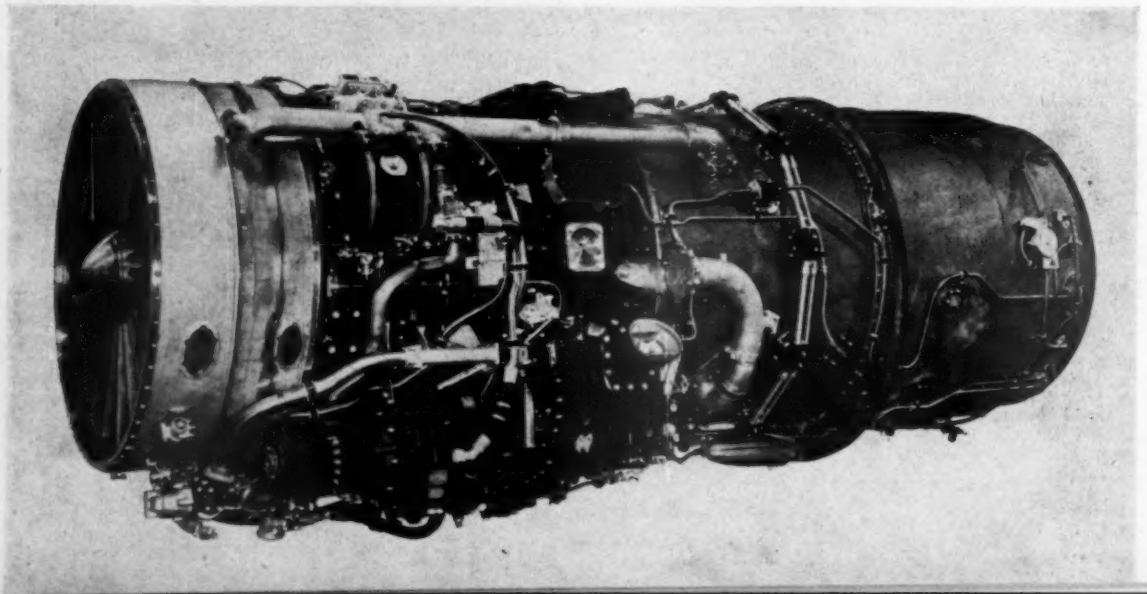
Of these the Turmo 600 is the Blackburn-developed Turboméca engine of the same name and has been selected as the powerplant for the Saunders-Roe P.531 five-seat helicopter. An engine of the free-turbine type, the Turmo has a maximum continuous power output of 366 s.h.p. (371 c.v.) and a weight of 310 lb. (141 kg.). It has a single centrifugal compressor and an annular combustion chamber.

Blackburn's latest powerplant—seen for the first time in public at the S.B.A.C. show last year—is their 840 s.h.p. (850 c.v.) A.129. This is a free-shaft engine based on the Artouste to the centrifugal compressor of which has been added two axial stages. At the rear of the new gas-generator unit so formed has been added a Turmo free turbine and reduction gear.

Although initially this interesting new powerplant is in the 800-850 s.h.p. bracket later versions are planned to give



The Alvis Leonides Major in its new helicopter version.



With a guaranteed minimum thrust of 16,500 lb., the Rolls-Royce Conway R.Co.10 is intended for civil applications.

970 s.h.p. (985 c.v.). First application of the engine is likely to be in the Saunders-Roe P.531 helicopter. The company also has under consideration its use as a turboprop engine for fixed-wing aircraft.

The Blackburn A.P.U. on show at Le Bourget is one using one of the company's standard Palouste air-bleed engines and having its rotating shaft assembly extended forward to a power output gearbox. This enables maximum electrical output to be obtained from the shaft drive with no delivery of compressed air; alternatively there can be full air delivery with no electrical output, or any required combination of compressed air and electrical power.

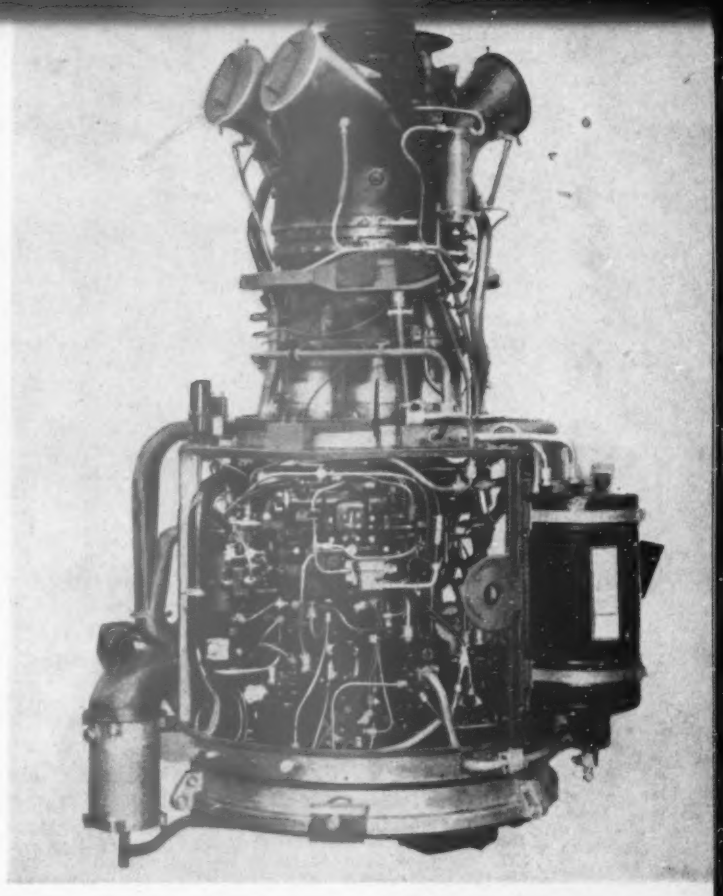
Units of this type can supply bleed air for such things as main powerplant starting, air conditioning, or de-icing; and shaft-power for generating electrical or hydraulic power. Its maximum continuous output is 2.4 lb./sec. (1.09 kg./sec.) of air at 37.5 p.s.i.g. (2.64 kg./cm.²) and zero shaft power or 1.95 lb./sec. (0.89 kg./sec.) at 40.5 p.s.i.g. (2.85 kg./cm.²) and 100 s.h.p. (101 c.v.).

The Palouste air-bleed gas-turbine engine is also used for ground engine starting units and trolleys incorporating these have been supplied by Blackburn to the Royal Navy and the R.A.F. These, too, are to be seen at Paris.

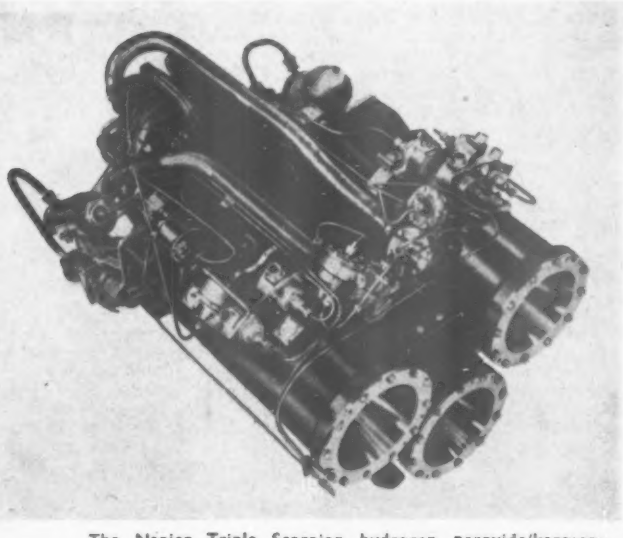
An air delivery flow of 2 lb./sec. (0.91 kg./sec.) at 38.5 p.s.i.g. (2.70 kg./cm.²) is available from these starter units. The temperature of this air is 220° C. and the fuel consumption of the unit, 290 lb./hr. (132 kg./hr.); 4,000 aircraft-engine starts can be accomplished between Palouste overhauls.

Something new in the air starting equipment from Brough is a starter truck—a self propelled version of the trolley. Again using a Palouste as the essential source of compressed air the truck is a 15-cwt. Commer vehicle.

Bristol Siddeley's display of powerplants is remarkable for the fact that it illustrates so clearly the way in which the products of the two component companies—Bristol Aero Engines and Armstrong Siddeley Motors—who merged some months ago, are complementary to each other. In the big



A free-turbine engine, the Napier Gazelle powers the Westland Wessex and Bristol 192 helicopters; this is the powerplant as a "change unit."



The Napier Triple Scorpion hydrogen peroxide/kerosene rocket engine.

turbojet field, for example, there is the Olympus 201 which completed an official Type Test at a rating of 17,000 lb. (7,711 kg.) a year ago and is claimed to have the highest thrust/weight ratio of any type-tested high-thrust turbojet. A static thrust of no less than 24,000 lb. (10,886 kg.) is delivered by this engine using Bristol Solar fully variable reheat.

There has already been mention of more advanced versions of the Olympus and recently there was news of an Olympus B.O1.21. A "developed" version of the Olympus has been selected as the powerplant for the new TSR-2 tactical-support reconnaissance "Canberra replacement" aircraft for the R.A.F.

Fourteen different aircraft types are powered by the Orpheus turbojet—the current 803 version, which is on show, in sectioned form, having a type-tested thrust rating of 5,000 lb. (2,270 kg.) and a thrust/weight ratio of 5.99 : 1. Aircraft using the Orpheus include the Breguet Taon which holds the World Class record for a 1,000-km. closed circuit, the Dassault Etendard V1, the Fiat G.91 light strike fighter for the NATO air forces, the Folland Gnat in India, Finland and Yugoslavia, the Gnat Trainer for the R.A.F., the Japanese Fuji TIF-2 trainer, and the Lockheed Jet Star utility jet transport. The Orpheus is being built in France, India and Italy.

A more advanced version, the Orpheus B.Or.12, developed under the U.S./U.K. Joint Mutual Weapon Development Programme for the second generation NATO light strike fighter is also on show. This engine has a basic thrust of 6,810 lb. (3,100 kg.) and has run at 8,650 lb. (3,920 kg.) thrust with simplified reheat. Within nine weeks of its first run the B.Or.12 completed a 150-hr. endurance test to the new fighter type-test schedule. The engine is scheduled to fly in a Sabre later this year.

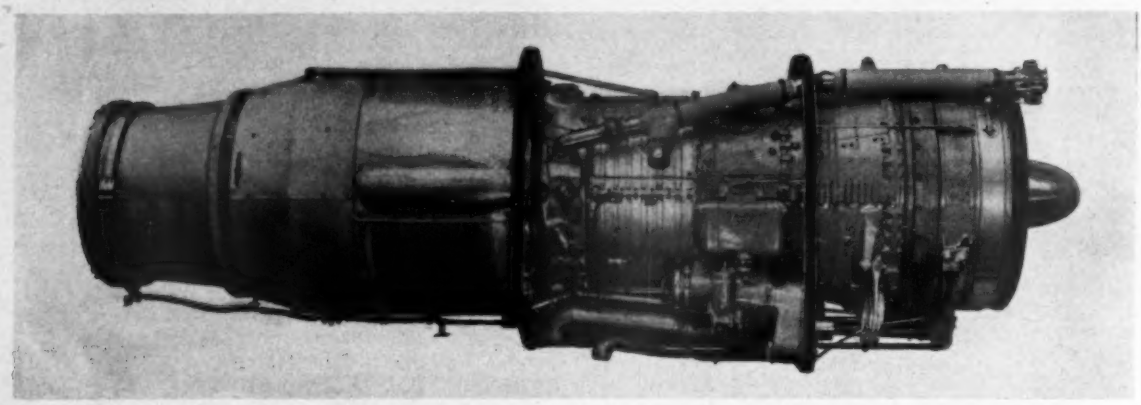
A small turbojet in the Bristol Siddeley range, the Viper ASV-11 delivers a thrust of 2,500 lb. (1,134 kg.) for a weight of 500 lb. (226 kg.). The version shown is the latest development in the series which in ASV-5 and ASV-8 versions have powered the R.A.F.'s Jet Provost basic trainers. The Viper is also used in the Jindivik pilotless target aircraft and is in production for the Italian Macchi 326 jet trainer.

Largest of the Bristol Siddeley propjet engines in production is the Proteus, one of the 760 Series powerplants being on show. This is, in fact, a Proteus 765—the type now being used in all Britannias at present in production. It has a take-off power of 4,445 e.h.p. (4,506 c.v.) and a cruising power of 2,670 e.h.p. (2,710 c.v.) at 25,000 ft. (7,620 m.) and 315 knots (602 km.p.h.). At this cruising condition it gives a fuel consumption of 0.486 lb./e.h.p./hr. (0.217 kg./p.e.c.v./hr.).

The Proteus is noteworthy in having a reverse-flow layout in which the compressor is to the rear of the engine and the turbine forward. The combustion chambers are grouped around the rotating assembly and by this means the powerplant is considerably shorter than is usually the case in propjet engines.

Shaft-power turbine engines in the 1,000-s.h.p. (1,014 c.v.) category also figure in the Bristol Siddeley range and are on show. These new units are the P.181 and P.182 intended for helicopter and fixed-wing applications respectively. They both use the same gas-generator design and both have independent power turbines.

The compressor of these engines has a two-stage axial unit with wide-chord blades and a single-stage centrifugal unit. An annular type of combustion chamber has been selected and designed to have a considerable amount of reverse flow to give a very short chamber assembly. The three-stage turbine



Largest of the present range of Bristol Siddeley turbojets is the Olympus; this version is the Mk. 201 giving 17,000 lb. thrust without reheat.

At the Paris Salon . . . .

has two stages driving the compressor and the third stage driving the power output shaft.

A very small liquid rocket engine on show is the PR.23 seen at Farnborough last year. This is also an HTP/kerosene unit and is intended for such duties as an aircraft powerplant for operation at extreme altitude; a performance boost unit; or a vernier unit for ballistic missile control. It weighs 32 lb. (14.5 kg.) and delivers a thrust of 500 lb. (227 kg.).

Last of the Bristol Siddeley powerplant exhibits is an auxiliary power unit of the type now made by the company under licence from the American AiResearch concern. Three types are available. One of these is for providing compressed air only and delivers 2 lb./sec. (0.9 kg./sec.) at 35 p.s.i.g. (2.5 kg./cm.^{2}) and 190° C.; it weighs 200 lb. (90.7 kg.). The second type is for giving either this amount of compressed air or 400 s.h.p. (406 c.v.) or any combination of these up to 50,000 ft. (15,240 m.). The third unit gives shaft power only and is available in a range from 30 s.h.p. (30.4 c.v.) units weighing 40 lb. (18 kg.) to 170 s.h.p. (172 c.v.) units.

Pride of place on the **de Havilland Engine Company's** stand is a beautiful half-cowled model of the turboprop version of the company's new 1,000-1,400 s.h.p. (1,014-1,420 c.v.) Gnome, designated the P.1000. This power unit is of particular interest for its small size and for its unusual layout.

Based on the H.1000 Gnome shaft-turbine engine intended as a helicopter powerplant with a rear gearbox and power output shaft, the P.1000 Gnome has its propeller shaft mounted above it. The rear gearbox provides initial engine speed reduction from a nominal 20,000 to 6,000 r.p.m. and a front gearbox effects the final reduction to the propeller shaft.

The model shown has a very neat cowling with NACA flush-type intakes to a plenum chamber. The constant-speed propeller is a three-bladed unit of 11 ft. diameter; it is equipped with an automatic overspeed protection device.

The de Havilland Gnome has been derived from the General Electric T-58. It is of the free-turbine type and has a 10-stage compressor and a two-stage power turbine. It uses an annular combustion system and for helicopter use has a one-hour rating of 1,000 s.h.p. (1,014 c.v.) for a specific fuel consumption of 0.65 lb./hr./s.h.p. (0.3 kg./hr./c.v.); with reduction gear this engine weighs 350 lb. (159 kg.). The Gnome has been chosen as the powerplant for the new Agusta helicopter.

A powerplant of a very different sort on the de Havilland stand is the Gyron Junior. This is the powerplant that has been chosen for the Royal Navy's new low-level strike aircraft, the Blackburn and General Aircraft NA.39. The engine displayed is the initial version seen at the S.B.A.C. show last year—which has a static thrust of 7,000 lb. (3,180 kg.).

Turboprop and rocket engines are a feature of the **Napier** stand. Of these the first will be represented by two engines, an Eland and a Gazelle—both cut-away and rotating to show their internal features.

In its straightforward turboprop form the Eland 504 delivers a take-off power of 3,500 e.h.p. (3,550 c.v.) and weighs (dry) 1,820 lb. (826.3 kg.).

Another version of the Eland comprises the basic power unit with the addition of a hydraulic clutch through which is driven an auxiliary compressor. This powerplant was devised for the original Rotodyne VTOL airliner with the engine delivering shaft power to a propeller for forward propulsion and compressed air for the rotor tip-jet units.

A shaft-power Eland for helicopter application is the Eland 229A for the Westland Westminster. This has a maximum 1-hr. rating of 2,600 s.h.p. (2,640 c.v.). For production craft of this type a development of this engine will give a maximum one-hour rating of 2,850 s.h.p. (2,890 c.v.).

Napier's other shaft turbine engine on show is the Gazelle helicopter powerplant used in the Westland Wessex and Bristol Type 192. This engine has been designed for operation at any angle between the vertical and horizontal. It weighs 865 lb. (393 kg.) and has a 1-hr. rating of 1,450 s.h.p. (1,472 c.v.).

Intended as an aircraft power unit or for missile application the Napier Scorpion HTP/kerosene rocket engine has been built in three versions, with single, double and triple chambers. No details of the weight or performance of these Scorpions are available. The Double Scorpion underwent flight trials in a Canberra in 1956 and in August the following year set up a World height record for aeroplanes.

A very small peroxide rocket developed by Napiers is intended for use as a take-off boost unit for helicopters. It comprises simply a catalyst pack and a de Laval nozzle. One of these units is mounted on each rotor blade tip and they are fed with fuel from a tank installed over the rotor hub.

Most powerful of the **Rolls-Royce** engines on show at Paris is the Conway R.Co.10 by-pass turbojet which has a guaranteed minimum dry thrust rating for take-off of 16,500 lb. (7,500 kg.). This is the civil version chosen for the Boeing 707-420. Conway engines in a military form power the Victor B.2 V-bomber and one version, the R.Co.15, has a guaranteed minimum dry thrust of 18,500 lb. (8,400 kg.).

Two versions of the Avon are on show—one with, and the other without, reheat. The former is the RA.24, the latest military Avon; no thrust figure has been released for it with reheat, but its dry thrust is 11,250 lb. (5,100 kg.). This particular version of the Avon has air-cooled turbine blades and claims the distinction of being the only military engine in service to have this feature.

The other Avon displayed is the civil RA.29 as used in the Comet 4 on B.O.A.C. regular services. This engine has a take-off thrust of 10,500 lb. (4,760 kg.) and an overhaul life of 1,000 hr. It is the first Avon to have a 16-stage compressor and a three-stage turbine. Other civil Avons are under development; they will have thrust of 11,700 lb. (5,310 kg.) and 12,500 lb. (5,670 kg.).

Rolls-Royce are also showing a Tyne turboprop. This is the engine that has been chosen for the Vickers Vanguard and will power the Canadair CL-44 transport for the R.C.A.F. and the Short Britannic for the R.A.F. Another version is being developed for the Fairey Rotodyne.

The Tyne is a two-spool engine which in its initial form delivers 4,985 e.h.p. (5,060 c.v.) for take-off. Later versions will give 5,525 e.h.p. (5,610 c.v.) and 5,730 e.h.p. (5,810 c.v.) the last being for the Canadair CL-44. Cruising specific fuel consumption is quoted as 0.388 lb./e.h.p./hr. (0.174 kg./c.v./hr.) at 425 m.p.h. (685 km.p.h.) at 25,000 ft. (7,620 m.).

The Rolls-Royce RB.108 turbojet displayed is of particular interest as a powerplant designed specifically for the jet-lift application. Five of these engines are used in the Short SC.1.

Giving a take-off thrust of 2,010 lb. (910 kg.) for a dry weight in the region of 250 lb. (113 kg.), the RB.108 has a seven-stage axial compressor and a single-stage turbine.

No display of Rolls-Royce powerplants would be complete without the ubiquitous Dart. At Paris this year the company features on its stand a number of Dart components which have achieved long life in airline service.

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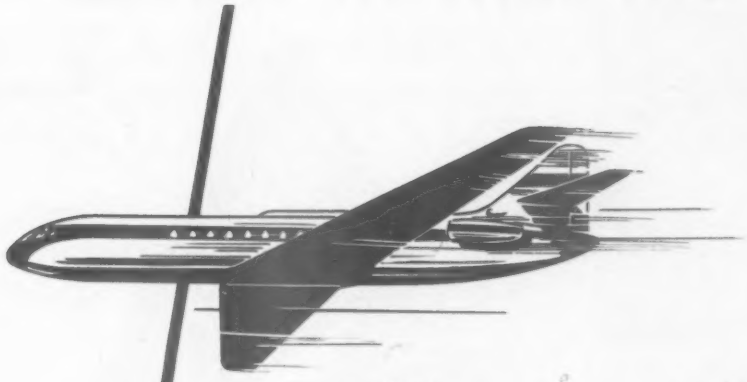

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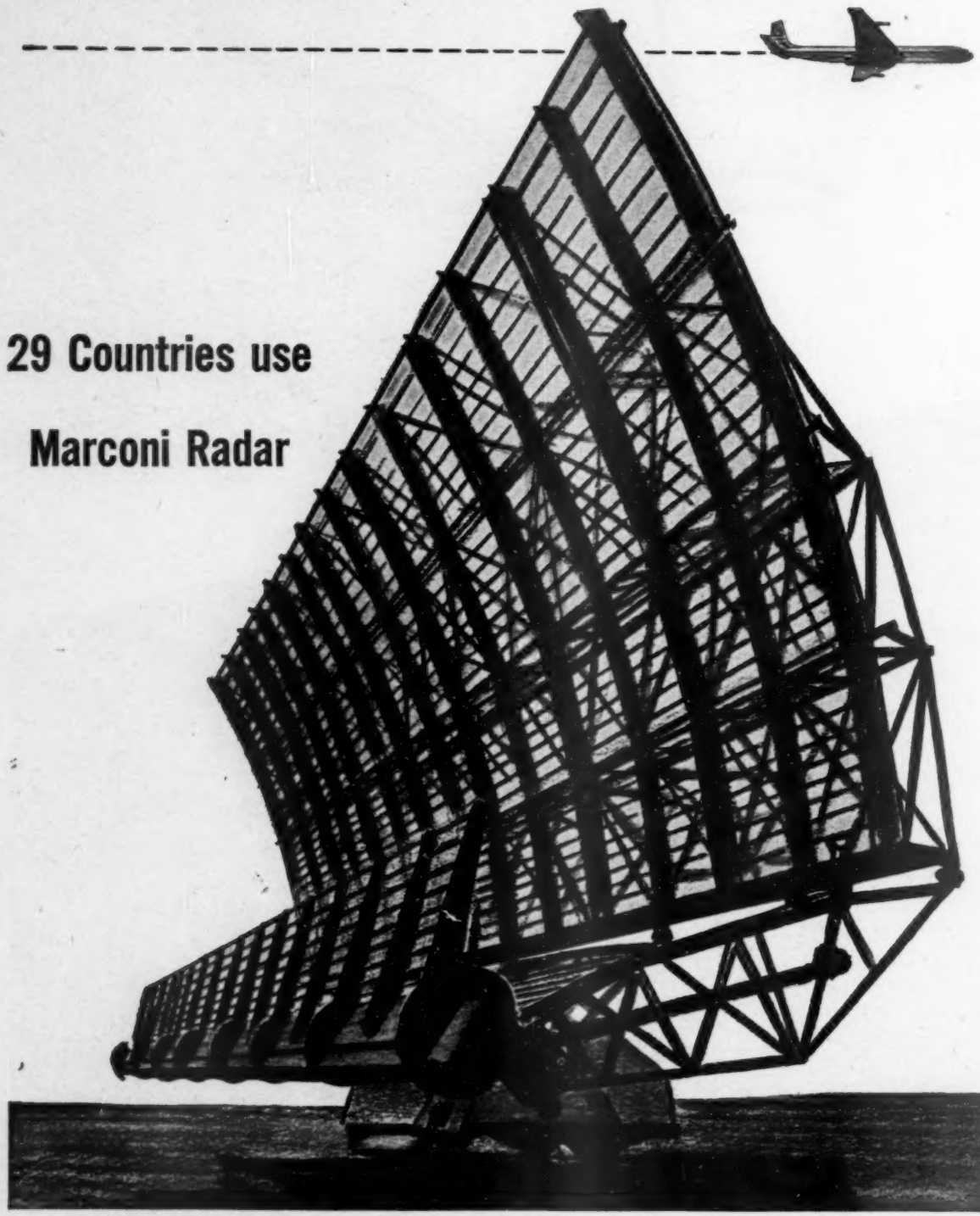
Marconi in Radar



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M6R

At the Paris Salon . . . .

Equipment and Accessories

A survey based on the latest list of exhibitors from the Salon Authorities at the time of going to press.

ACRATORK

Through its agents in France the Acratork Engineering Co., Ltd., is exhibiting its range of torque loading equipment. This comprises a selection of spanners and wrenches providing for all torque loads from 4 oz.-in. to 850 lb.-ft. and a variety of test and setting rigs for torque spanners. A 3,000-lb.-ft. hydraulic torque generator is also available.

AIR ENGINE SERVICES

On the stand of Air Engine Services (U.S.-U.K.), Ltd., is a Pratt & Whitney R.1340-40 powerplant which has been completely overhauled at the company's works and built up as an engine change unit ready for immediate installation in a Westland S.55. Pratt & Whitney spares are also on display.

AVICA

Products on the stand of Avica Equipment, Ltd., include stainless steel flexible pipe assemblies for fuel, oil and air supply lines working at high pressures and temperatures; stainless steel bellows assemblies as expansion joints and high-pressure swivel pipe couplings. Other exhibits are rigid tube couplings; support clamps for flexible and rigid pipe systems; flexible fuel line and quick disconnect couplings and rubber hose assemblies.

BELL'S

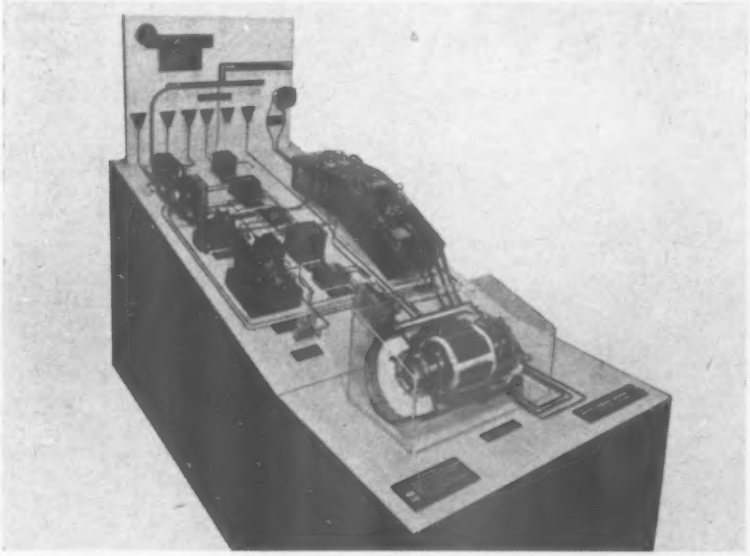
A general range of Bestobell products, including asbestos fire seals, synthetic rubber and asbestos mouldings, and silicone rubber components for air conditioning and de-icing systems are exhibited by Bell's Asbestos and Engineering, Ltd. Among the new products on show there are silicone and Terylene collapsible air starter hose, improved types of Flexitwist silicone rubber and glass fibre hot-air hose and a stainless steel wire mesh fire seal.

BRISTOL AEROJET

On the stand of Bristol Aerojet is a selection of rocket motor cases and high-pressure storage vessels for use on guided missiles and aircraft. Among the exhibits is the motor case manufactured by the company for the Raven solid propellent rocket motor for the IGY Skylark rocket.

A Vanguard anti-icing heat exchanger and shutter assembly produced by Delaney Gallay.

Used for oxygen, air or nitrogen, the pressure vessels in current production are usually of low-alloy steel. Bristol Aerojet is also developing resin-impregnated glass fibre for this purpose.



An electrical layout and principal components of the British Thomson-Houston variable-speed AC/DC power system for aircraft.

This Dowty main undercarriage for the Fokker Friendship and its U.S. equivalent, the Fairchild F-27, is on show.

BRISTOL SIDDELEY

Ball screws and splines are exhibited by Bristol Siddeley Engines, Ltd. Manufactured at Coventry under a technical agreement with Beaver Precision Products, Inc., of Clawson, Michigan, ball screws are employed on the movement of such items as flaps, tailplane, undercarriage, canopies and escape hatches where high air loads and extreme temperatures are encountered.

BRITISH THOMSON-HOUSTON

The main exhibit by the British Thomson-Houston Co., Ltd., which forms part of the Scintex st... d display, consists of a diagrammatic layout showing the principal components of the variable-speed AC/DC power system, similar to that installed in the Comet 4. Also displayed is a selection from the range of BTH aircraft equipment, including high-energy ignition units, switches and motors.

CIBA (A.R.L.)

Redux adhesives and Aeroweb metal honeycomb applications in modern aircraft form the main theme of the CIBA (A.R.L.), Ltd., stand. On display are applications of Redux and Aeroweb in the Vanguard, the Comet 4, the Argosy, the Friendship and the Alouette. Redux bonding has now been employed in more than 70 different types of aircraft, and Aeroweb is used extensively in the aircraft and missile industries.

COSSOR

Elements of a type 2A secondary radar system are exhibited by Cossor Radar and Electronics, Ltd., on the stand of C.T. (London), Ltd. This radar aircraft identification system consists of a ground unit, known as the interrogator and responder, and an airborne receiver and transmitter known as a transponder.

In a secondary surveillance radar system the interrogator transmits a coded sequence of pulses on one frequency which are received by the airborne equipment; this, if the coding is appropriate, transmits a differently coded sequence of pulses on a different frequency.

At the Paris Salon . . . .

Originally produced as a casting this Rotol component in Hiduminium 66 is now manufactured by High Duty Alloys as a forging by the re-entry technique.

DELANEY GALLAY

Examples of all the products manufactured by Delaney Gallay, Ltd., are on show, including primary and secondary surface oil coolers, anti-icing heat exchangers, thermal insulation blankets and ducting, stainless steel toilet units and examples of flux bath brazing and stainless steel fabrication.

The company is also exhibiting its new Incorporall portable welding kit for mild and stainless steels. Other welding equipment suitable for spot, seam or protection welding is also shown.

DOWTY

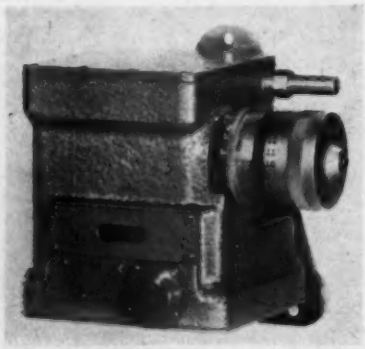
The Dowty Group—including its newest member, Rotol, Ltd.—is displaying a wide variety of exhibits on its stand. Among these are two new units—the Dowty Moog valve and the Rotol hydro-mechanical constant-speed drive—a range of undercarriages, hydraulic equipment, a propeller and a propeller brake, ram air turbines, gearboxes and electrical equipment. The Moog valve is an electrical-hydraulic servo valve for control systems requiring electrical signalling to be converted into hydraulic force.

DUNLOP

The Aviation Division of the Dunlop Rubber Co., Ltd., is showing tyres, wheels, brakes, Maxaret anti-skid units, de-icing equipment and windscreen wipers, with particular emphasis on the company's equipment for the Caravelle. 3,000 p.s.i. compressors and pneumatic actuating valves are also on display.

E.M.O. INSTRUMENTATION

Two units for checking and cleaning precision bearings—a torque testing machine for measuring their starting and running torques and a bearing washing machine—are exhibited by E.M.O. Instrumentation, Ltd. The company is also displaying precision bearings which are used in the manufacture of gyro flight instruments, computers, cold-air units, servo motors, and so on.



One of the new developments to be seen in the Mechanism display is this type M.1847 precision aneroid barometer. It is particularly suitable for aircraft and workshop use.

ENGLISH ELECTRIC

The Aircraft Equipment Division of the English Electric Co., Ltd., is exhibiting AC and DC electrical system components for aircraft together with servo actuators, blowers, fuel pumps and a number of guided missile units. Typical of the AC equipment for the Victor 2 and Vulcan 2, the display includes a type AE 8005 civil constant-speed drive and a type AE 2043 40kVA brushless generator for a high performance AC system.

The instrument wing of the Guided Weapons Division of English Electric Aviation, Ltd., has a display of guided weapon rate and integration (Honeywell) gyros and accelerometers for such applications as stable platforms for inertial navigation.

GARRINGTONS

Compressor and turbine blades forged to oversize, close or precision limits in a number of alloys such as aluminium-bronze, steel and titanium, are on the stand of Garringtons, Ltd. Also on display is an aircraft flap selection unit devised by B.O.A.C., a new type universal joint especially adaptable for controls and systems of leverage where angular variations are encountered, and a Gydelite reflecting stud for marking taxi-ways and perimeter tracks in place of electric lighting.

GODFREY

Many types of air conditioning and cold-air equipment for both military and civil aircraft are exhibited by Sir George Godfrey and Partners, Ltd. These include a selection of cold-air units for fighters, bombers and transports; a refrigerant compressor for cooling airborne equipment; a flow control valve for use in air ventilated suit systems; and water extractors.

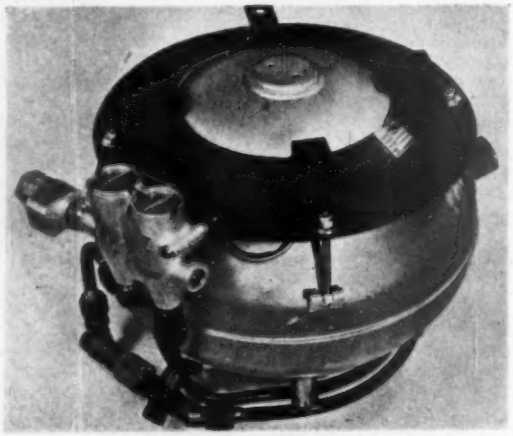
HARLEY

A range of landing lamps for fixed wing aircraft and helicopters and a model T mobile floodlight is exhibited by Harley Aircraft Landing Lamps. Types displayed include electrical retractable, leading edge, and nosewheel, landing and taxi lamps.

HAWKER SIDDELEY

In addition to aircraft and guided missile exhibits in the flying and static shows, the Hawker Siddeley Group is displaying a number of electronic and instrument products. There are three working exhibits—a five-channel display unit, complete with camera; a telemetry sampling switch and a sweep frequency oscillator—together with a transistor galvanometer amplifier, a UHF receiver, UHF oscillator and directional coupler.

Flight deck automatic temperature control equipment, as supplied for use in the Vanguard, an electro-hydraulic servo valve, fuel flowmeters and fuel flow proportioning valves are also displayed on the stand.



A five litre, lightweight stainless steel, liquid oxygen converter from the new range of liquid oxygen equipment being produced by Normalair. It has a working pressure of 100 p.s.i.

HIGH DUTY ALLOYS

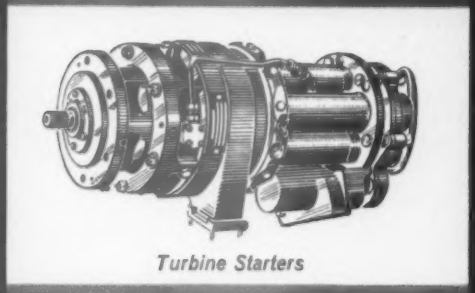
Items illustrating the special techniques used by High Duty Alloys, Ltd., in the production of components and materials at its Production Division are exhibited on this stand. Re-entry forging, draftless forging, the production of components to a definite weight tolerance on totally enclosed dies, and precision forging products are displayed, together with Hiduminium sheet exhibits and examples of aircraft castings and extruded sections.

HOBSON

Hydraulic feel simulator units, constant-speed alternator drives, fuel system components and hydraulic pumps and motors are among the exhibits of H. M. Hobson, Ltd., and Integral, Ltd. A simulator unit for applying artificial feel to the elevator control of the Britannia is displayed with a power flying control unit for the Gnat and Caravelle flying control equipment. Electric and hydraulic motor-pump units are also on the stand.

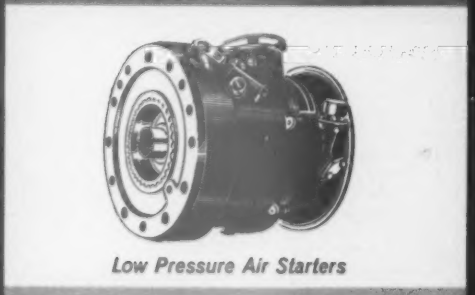
(*Continued on page 677*)

Cartridge Starters



Turbine Starters

Liquid Fuel Starters



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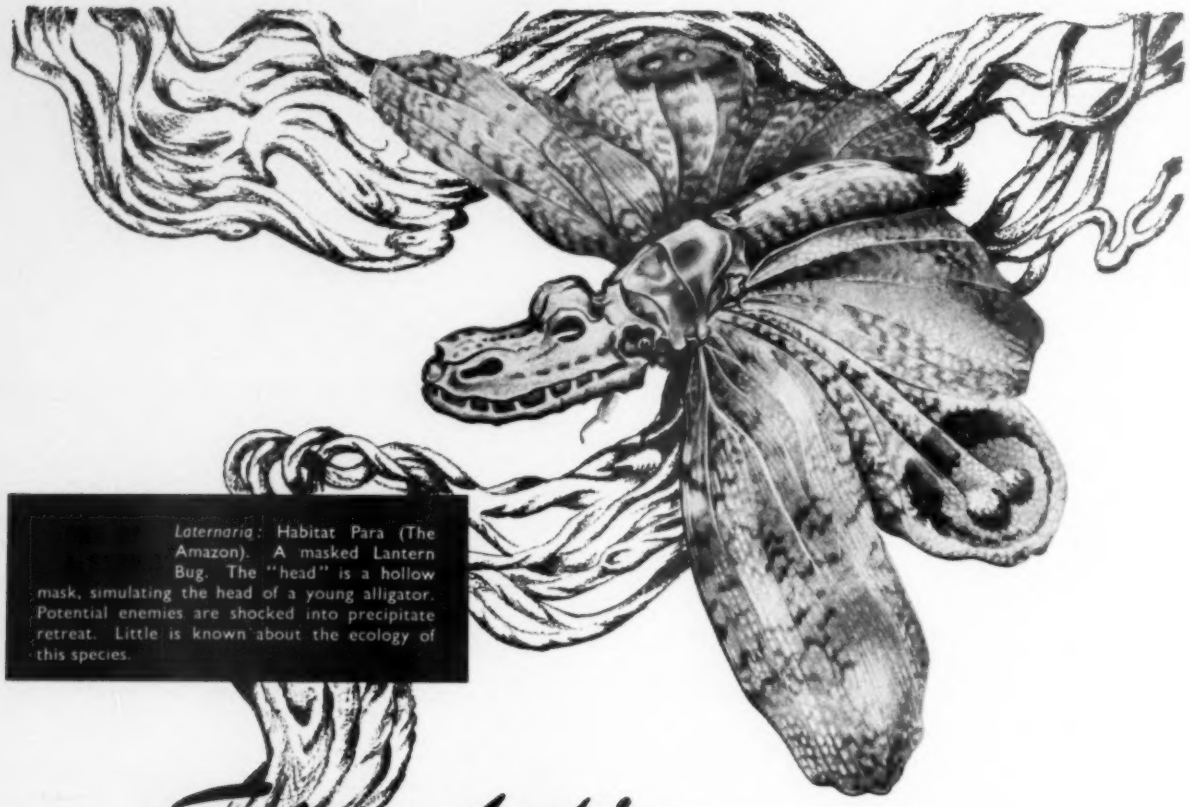

Laternaria: Habitat Para (The Amazon). A masked Lantern Bug. The "head" is a hollow mask, simulating the head of a young alligator. Potential enemies are shocked into precipitate retreat. Little is known about the ecology of this species.

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At the Paris Salon . . . .

(*Continued from page 676*)

LODGE
Lodge Plugs, Ltd., is exhibiting its full range of aviation sparking plugs and high-energy igniters, together with plug servicing equipment including a spark and leak tester and chemical clearing machine.

LUCAS
A comprehensive display of fuel system and combustion equipment for gas turbines, including sectioned and complete units comprising typical engine fuel systems, is to be seen on the stand of Joseph Lucas (Gas Turbine Equipment), Ltd. Of special interest is a quick release coupling for use in aircraft fuel, hydraulic and oil systems, and a range of sealing rings for hydraulic systems. Other items include fuel pumps, main engine controls and burner and combustion equipment

MARCONI
Four items from the Marconi's Wireless Telegraph Co., Ltd., range of aeronautical radio equipment are on show. These are a type AD 210C single-channel VHF direction finder for small airports; the type AD 712 crystal controlled automatic direction finder (ADF); the Marconi sub-miniature ADF type AD 722, which is primarily intended for pilot operation; and the type AD 308 HF transistorized airborne teleprinter receiver.

MARTIN-BAKER
A typical Mk. 4 Martin-Baker ejection seat is being displayed by Société D'Exploitation Des Matériels Martin Baker. This seat is fully equipped with parachute assembly, survival pack, emergency oxygen and personal equipment connector. It can be used from runway level, provided the forward speed of the aircraft is not less than 90 knots, and at any height and speed at present being flown by modern aircraft.

MECHANISM
Displayed on the stand of C.T. (London), Ltd., the range of aircraft cockpit instruments exhibited by Mechanism, Ltd., includes machmeters, air speed indicators, altimeters, engine power-loss indicators, and pressure gauges. Apart from these instruments the company is showing two of its developments for the first time—a precision aneroid barometer, suitable for airfield and workshop use; and an altitude warning device, developed in conjunction with B.E.A. for indicating to the pilot that his aircraft has passed through a pre-set altitude.

MURPHY
Two new items are being exhibited by Murphy Radio, Ltd., in their display of aeronautical equipment. One is the complete leader cable equipment which provides the azimuth guidance for the final phase of a B.L.E.U. Automatic Landing System and the other is the company's MR 380 twin-track tape reproducer.

NAPIER
In addition to engines and models D. Napier and Son, Ltd., is exhibiting specimens of castings produced by the Napiercast method of investment casting, and a Spraymat heated bullet. A larger Spraymat exhibit can be found on the stand of Bronzavia, S.A.

NORMALAIR
With its Canadian and Australian subsidiaries, Normalair, Ltd., is presenting a combined display, the theme of which is the company's ability to provide complete systems for aircraft pressurization and air conditioning, together with oxygen equipment. Units from pressure control, pneumatic flow control, temperature control, air cycle cooling, vapour cycle cooling, and oxygen systems are displayed on the stand.

PLESSEY
A selection of AC electrical system equipment is being exhibited by Plessey International, Ltd., together with synchro and servo components from its associate company, Ketay, Ltd. Power Auxiliaries, Ltd., also of the Plessey Group of companies, is displaying seamless flexible metallic hose. Other Plessey divisions are exhibiting UK-AN electrical connectors, ground and airborne radio units, and hydraulic and pneumatic equipment.

ROTAX
In addition to its complete electrical systems for aircraft, starting systems for engines and other standard products, Rotax, Ltd., is placing the emphasis on new equipment. This range covers brushless and ram air turbo-alternators, a transistorized inverter, a low-pressure pneumatic starter, a flashing warning lamp and a navigation lamp flasher unit. A 15-kVA. bleed air turbo-alternator is also on display.

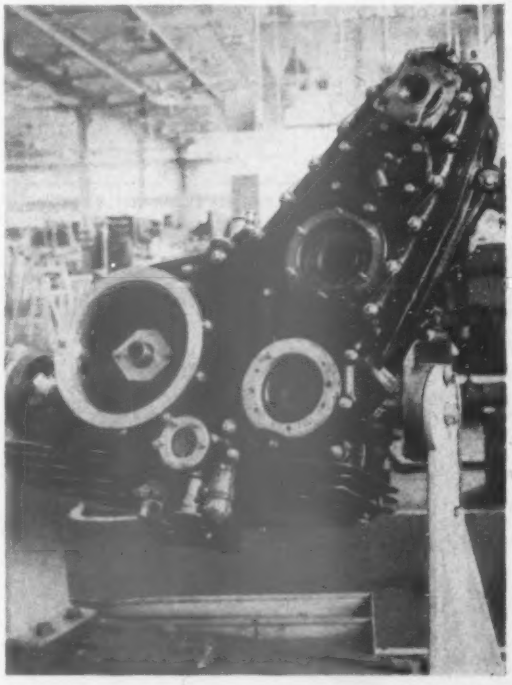
SHORT BROS.
In addition to aircraft and missile exhibits, Short Bros. and Harland, Ltd., is illustrating the control system of the Canberra U Mk. 10 developed by the company for pilotless operation in guided missile firing trials.

SMITHS
In collaboration with the Sperry Gyroscope Co., the Smiths Aviation Division is displaying a wide selection of products. On view is a mock-up of the flight panel of a modern four-engined jet transport, fully instrumented by Smiths, and individual exhibits include the SEP. 2 gyro unit, a flight data system and a selection of fuel gauging equipment and small motors. The mock-up flight instrument display shows the application of the new IFALPA cockpit recommendations for the basic T and a group of six central instruments.

SPERRY
In the main exhibition hall the Sperry Gyroscope Co., Ltd is displaying selected examples of advanced equipment under development, notably the visual flight director, twin-gyro stable platform, helicopter stabilization equipment, Rotorace gyrosyn compass, gyro horizons, miniature servo components and a design of automatic pilot for high-performance aircraft. In addition the Sperry stand is linked with that of Smiths by a feature on the Airco D.H. 121 transport.

VINTEN
Exhibiting on the stand of C.T. (London), Ltd., W. Vinten, Ltd., is displaying a number of cameras and associated equipment from its range of photographic products. The company's present production programme of airborne cameras includes a 70-mm. reconnaissance camera designed specially for low-level work, a 16-mm. combat recording camera (G.90) for the R.A.F. and a 35-mm. geological survey camera.

HENRY WIGGIN
This display features the widespread uses to which Nimonic and Nimocast high-temperature alloys manufactured by Henry Wiggin and Co., Ltd., are put in gas turbine, ramjet and rocket engineering. A secondary display shows some of the aircraft applications and other Wiggin nickel alloys including Inconel, Monel, "K" Monel, the Nilo and the Bright Ray series.



One of the four Rotol gearboxes installed in the Vanguard. Its function is to provide mounting faces for the aircraft's various accessories, which are driven through gears and quills, the engine power being transmitted by the gearbox drive.

Fighters from Sweden

FOR so small a country, Sweden has a remarkably large and virile aircraft industry, whose products are competing internationally with some of the best equipment produced by the major Powers. The SAAB Aircraft Company, which was established as a privately owned organization in April, 1937, has specialized in fighter development and production, and the latest of its line, the single-seat Mach 2 Draken, is scheduled to be displayed at Paris. With it will be shown the transonic two-seat SAAB-32 Lansen, which is being delivered in attack, all-weather fighter and tactical reconnaissance versions to the Royal Swedish Air Force.

The prototype Lansen first flew in November, 1952 and as the A32A, was initially ordered for all-weather attack duties in 1953. Powered by a 10,000-lb.-s.t. Rolls-Royce Avon R.A.7R, built in Sweden as the R.M.5, the A32A began replacing the T18Bs of the R.S.A.F. in late 1955, and by the end of 1957, all four Swedish attack wings were operating Lansens.

Standard armament of the A32A is four 20-mm. cannon, plus underwing bombs, rockets or Napalm. It has also been developed to carry two Swedish Type 304 air-to-surface missiles.

Production of the A32A was completed by mid-1958, after several hundred aircraft had been built, but meanwhile, a new version of the Lansen, the J32B, had made its first flight on January 7, 1957. With new fire-control equipment and navigational radar, and a considerably more powerful R.M.6 Avon with a Swedish-designed afterburner, the J32B was developed for all-weather and night fighting, armed with cannon and unguided rockets. Late last year, the J32B began to replace the D.H. Venom N.F.51 in R.S.A.F. service, and a further wing is being formed with this type.

Latest variant of the Lansen is the S32C, for photographic-reconnaissance, which made its initial flight on March 26, 1957.

Apart from its Mach 2 performance, which puts it among the fastest fighters now flying, the latest version of the SAAB-35 Draken is distinguished by the phenomenal initial climb rate of some 50,000 ft./min. This supersonic climb is quite an extraordinary achievement on the power of a single 15,700 lb. afterburning R.M.6 (Avon 200 series) turbojet, but in the Draken is combined with an equally outstanding short field performance.

The original R.S.A.F. requirement in 1949 for a new single-seat fighter to intercept transonic bombers specified a maximum speed of M=1.4-1.5, but some time later, in 1956, this was increased to M=1.7-1.8. A delta wing of low aspect ratio was selected for the optimum speed and sufficient volume for fuel, armament and equipment, but the C.G. limitations resulted in an unnecessarily long and heavy fuselage.

The double-delta layout, with extreme sweep on the inner wing sections, was therefore examined, and for full-scale flight tests, it was decided in mid-1950 to build a small experimental research jet with this configuration. Following wind-tunnel tests, and the flying of control-line models powered by small pulse jets, the SAAB-210 was produced, with an Armstrong-Siddeley Adder, and began research flying in December, 1951.

The little SAAB-210 confirmed the general suitability of the double-delta layout for high volumetric capacity, low structure weight, low drag and good intake efficiency, and the design team under Mr. Erik Bratt continued to develop the SAAB-35 on those lines. The long-chord inner wing section was finalized at 80° sweep, changing to 57° on the thin outer panels. The entire trailing edge sections of the wings were occupied by control surfaces, in the form of "elevons," split into inboard and outboard sections, the latter with mass-balance weights.

All the control surfaces, including the rudder, of the Draken, are each servo-operated by two irreversible hydraulic tandem jacks, fed by two separate power systems. Artificial feel is provided by a unit sensitive to Mach number and dynamic pressure, while a three-axis Lear autopilot is also fitted.

The hydraulic system imposed special problems in designing the Draken, which utilizes a duplicated arrangement operating at some 3,000 p.s.i. Because of the extraordinary acceleration after take-off, it was necessary to ensure the hydraulic retraction of the undercarriage within four seconds.

Much of the wing space is occupied by integral fuel tanks, while additional stowage is provided by integral and bag tanks in the front and rear fuselage sections. Extra fuel can be carried in place of the two 30-mm. cannon mounted in the inner wing sections, these weapons being supplementary to the primary armament of external air-to-air rockets or guided missiles.

The American infra-red homing Sidewinder has been selected to arm the Draken, which carries one of these weapons under each inner wing section. All-weather radar and fire-control equipment is also installed.

Three experimental prototypes of the J35 were ordered from SAAB in August, 1953, the first making its initial flight on October 25, 1955. Flight testing has since confirmed its excellent handling over an exceptionally wide speed range.

The Draken cannot be stalled under normal conditions of flight, and has been controlled down to 118-124 m.p.h. It has proved to be the first new R.S.A.F. fighter not to require increased runway-lengths, and needs less than 650 yd. landing run with braking parachute deployed and disc brakes.

First production version of the Draken, the J35A, made its initial flight on February 15, 1958, and showed an increase in speed from M=1.4 to M=1.8 compared with the prototypes. This variant is entering service with the R.S.A.F. fighter wings during 1959, and will later be joined by the J35B.

With a higher-powered Rolls-Royce engine and a new SAAB fire-control system for collision-course interception, the J35B is also intended for export, interest having been shown by several countries with airfields of restricted size and approaches. This Mach 2 variant of the Draken will also have ground attack capability, and is to be followed by a two-seat development for advanced training, the J35C. The J35B is due in squadron service in Sweden by the early 1960s for both interception and ground attack duties.

Technical Data (J35A)

DIMENSIONS (J35A).—Span, 30 ft. 10 in.; length, 56 ft. 7 in.; wing area, 538.2 sq. ft.

WEIGHTS.—Loaded, according to armament, 17,600-19,800 lb.

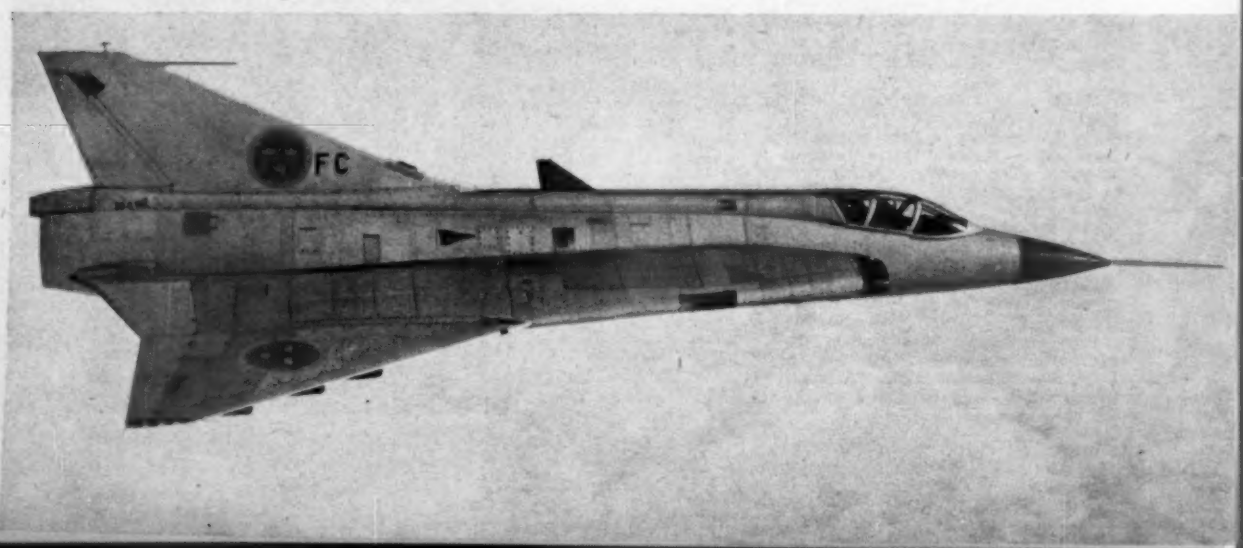
PERFORMANCE.—Max. speed, M=1.8; minimum flight speed, 130 m.p.h.; initial rate of climb, approximately 39,370 ft./min.; landing run, without brake parachute, 3,900 ft.

(A32A)

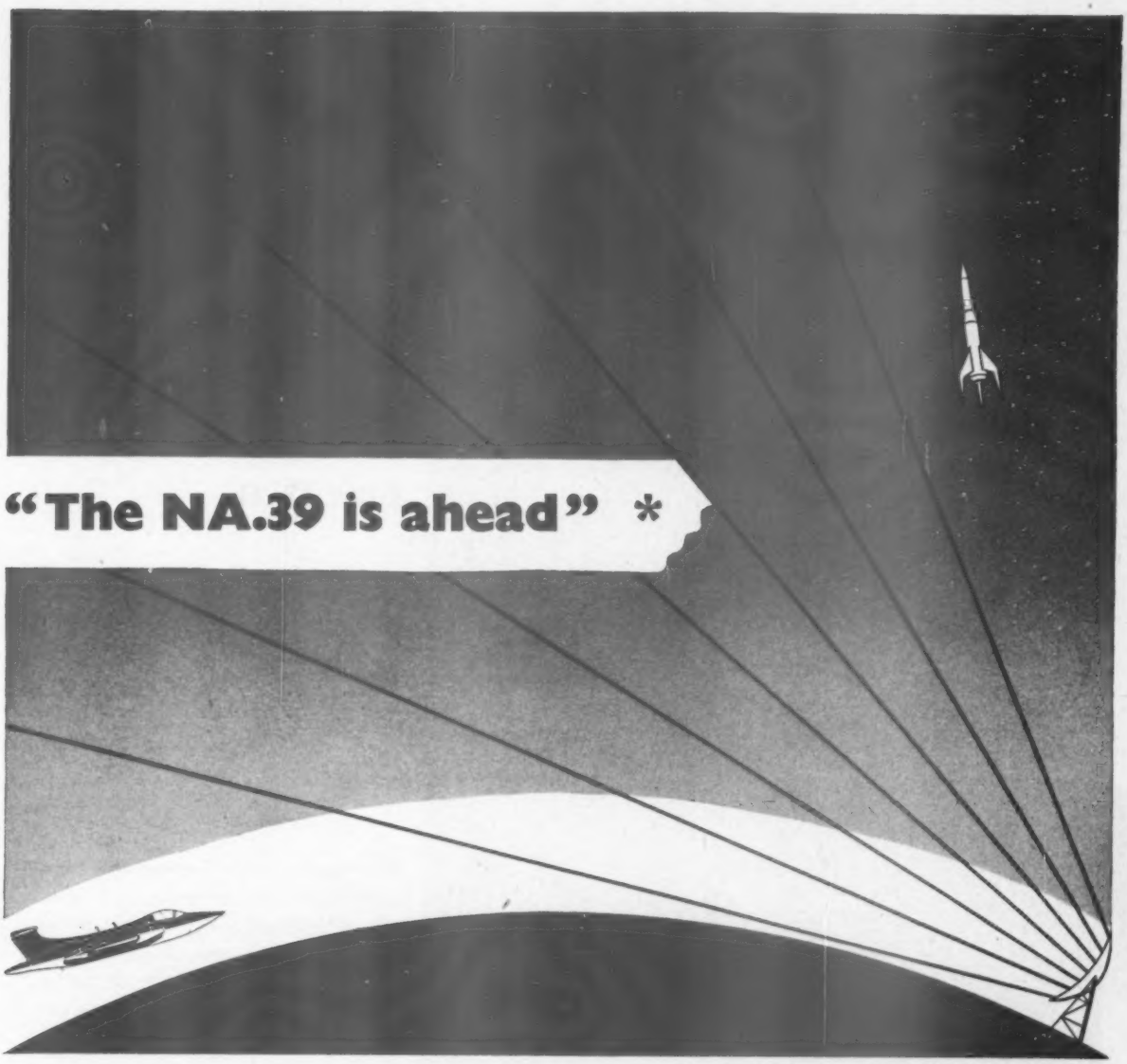
DIMENSIONS (A32A).—Span, 42 ft. 8 in.; length, 48 ft.; height, 15 ft. 6 in.; wing area, 402.5 sq. ft.

WEIGHTS.—Empty, approx. 15,400 lb.; gross, approx. 22,000 lb.

PERFORMANCE.—Max. speed, more than 700 m.p.h.; landing speed, 125 m.p.h.; service ceiling, 50,000 ft.



Latest version of the SAAB J35A Draken "double-delta" intercepter to be displayed at Paris has a modified rear fuselage and tail parachute stowage.



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ASTRONAUTICS and MISSILES

Packaged Propulsion

Kenneth Gatland describes the two-stage Polaris system

WHILE secrecy still shrouds many features of the Polaris, a little may now be revealed of its solid-propellent engines and their method of manufacture.

Few who have had the opportunity of studying the ballistic end of the Polaris weapon system would deny that it represents a most significant development. As recently as two and a half years ago, solid propellent rockets were regarded as completely inapplicable to 1,500-mile range ballistic missiles because of the relatively low specific impulse of solid as against liquid propellents. It was for this reason that the U.S. Navy, prior to 1957, had been considering for ship-board operations the Army-developed Jupiter IRBM.

However, the ship-board handling of such volatile fluids as liquid oxygen raised problems which were quite unacceptable to the Navy. The result was that, following up an encouraging lead given by the Jet Propulsion Laboratory, California Institute of Technology, the Naval authorities began seriously to investigate the possibilities of new solid propellent techniques.

In consequence, the Missile Systems Division of Lockheed Aircraft Corp. was made system manager and prime contractor for a two-stage IRBM—the Polaris—and Aerojet-General received the contract for its propulsion system.

Plastic Propellent

Present enthusiasm for solid missiles owes much to the work carried out with moulded propellents during the last War at the Jet Propulsion Laboratory, California Institute of Technology. This work began in 1942 when a propellent was produced under the designation GALCIT 53*.

In GALCIT 53 the oxidizer was potassium perchlorate, in the form of a white powder. In addition to being plentiful, it combined the optimum in available oxygen, heat of combustion, and chemical and physical stability. The fuel in the new propellent was a special type of asphalt; added to it was a small percentage of oil with an asphalt base.

The mixture was prepared by heating the asphalt and oil in a mixing kettle to a temperature of 350°F., then stirring in the perchlorate. Before the combustion chambers were filled with the finished propellent, they were lined with a hot mixture of asphalt and oil. When the propellent had cooled sufficiently, it was scooped into the combustion chambers, which were bounced a few times to assure uniform settling, then set aside for the propellent to harden.

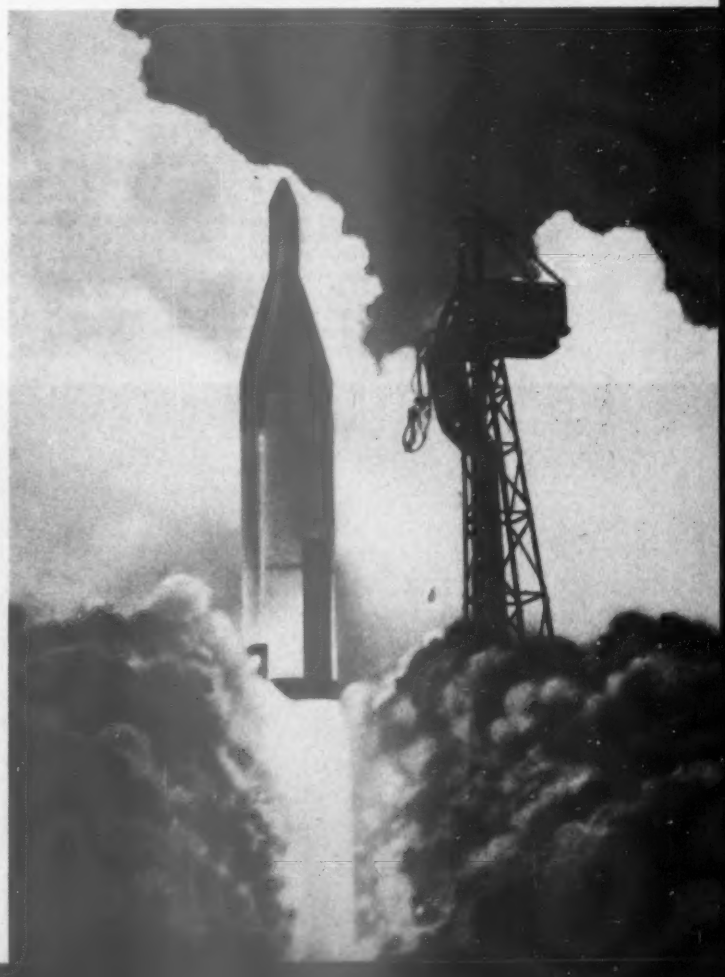
In its finished form, GALCIT 53 was a black plastic, at ordinary temperatures resembling stiff paving tar. It could be detonated with difficulty if at all. Only with patience could it be ignited with a match flame; but once ignited it burnt fiercely, emitting a white light and dense white smoke. Burning in a combustion chamber under a pressure of 1,800 p.s.i., the propellent gave an average exhaust velocity of 5,300 ft./sec. and an average burning rate of 1.25 in./sec.

The new asphalt-base propellent had several advantages over all earlier ones. It was easier to prepare, and the ingredients were more readily available; it could be stored at wider temperature limits, and within those limits it could be stored almost indefinitely without deteriorating, whereas the earlier propellents had a tendency in storage to pull away from the liner, leaving tiny cracks, which led to explosions.

A number of solid motors using asphalt-base propellents were produced by the Aerojet company for aircraft assisted take-off. Meanwhile, research at J.P.L. was being directed toward the development of a still more superior propellent in which a polysulphide polymer replaced the asphalt; this ushered in the present era of internal-burning grains and thin-wall engines, with a significant increase in mass ratio. Subsequently, this work moved on to include the polyurethanes, the fuel binder chosen for Polaris.

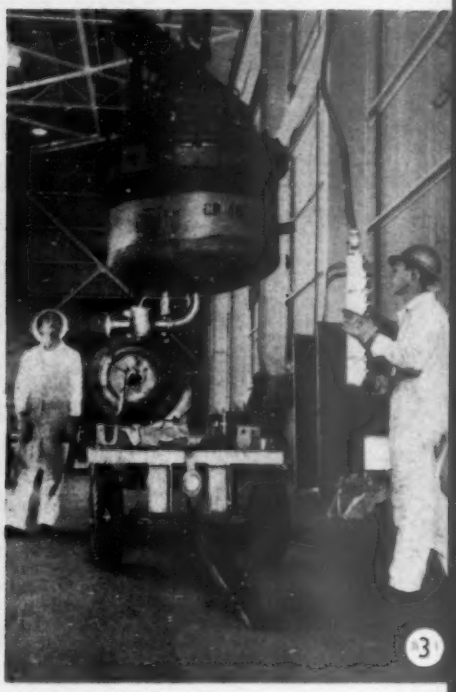
The Polaris Engine

The apparent simplicity of the Polaris power unit belies the intensive programme of research that went towards its development. A thin cylinder of h.t. steel is filled with a rubber-base propellent; down the middle of the rubber, running the length of the cylinder, is a star-shaped hole. This is the working chamber of a Polaris engine. The star shaped pattern, or grain configuration, was adopted to provide a larger burning



Polaris rising from its launching pad on a pillar of flame at Cape Canaveral, Florida

* "Research and Development at the Jet Propulsion Laboratory, GALCIT," British Interplanetary Society *Journal*, September, 1946, pp. 39-40.



surface than would otherwise have been afforded by a simple cylindrical core.

In developing this propellent, Aerojet drew heavily upon the resources of its parent firm, the General Tire and Rubber Co., which has done much of the original work with polyurethane, the synthetic substance from which foam rubber is made. Aerojet scientists, advancing on earlier work by the J.P.L., found that polyurethane, with some modification, was an ideal binder for solid propellents.

The polyurethanes had their origin in Germany in the 1930s and urethane foams are today commonly found in various household products. In a rocket application, the liquid polymers are catalysed and mixed with an oxidizer to produce a composite propellent which can be either cast or extruded.

An important attribute of the material in this form is its high adhesion properties, which means that the propellent grain will effectively bond to the wall of the motor case, which in consequence can be made much thinner. There is, moreover, the possibility of introducing into the propellent finely divided metals such as aluminium, magnesium or boron, to raise the heat content and boost performance—although this raises serious problems of nozzle erosion.

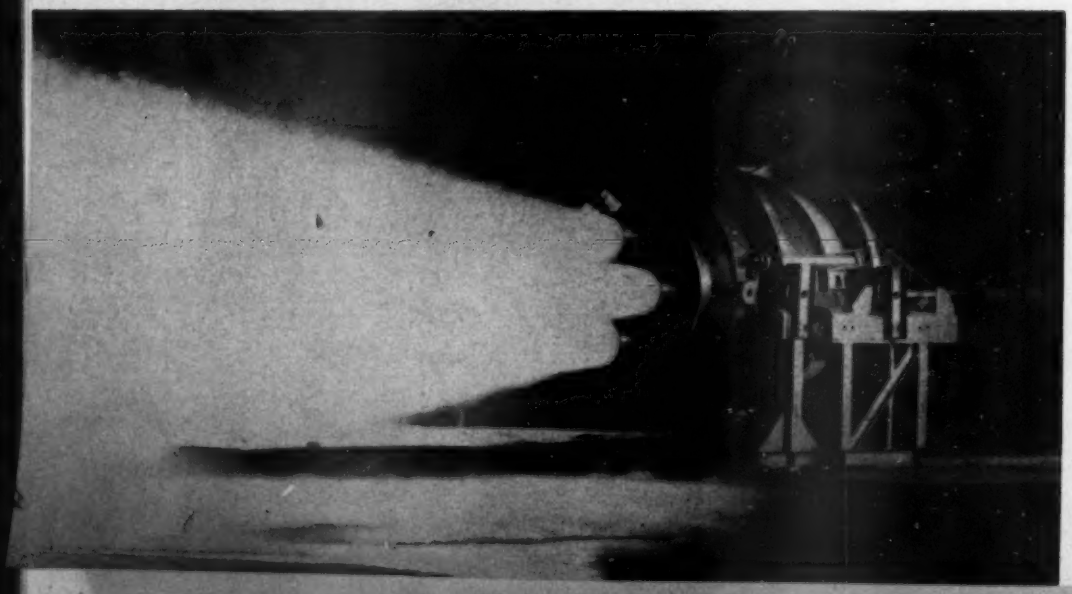
To meet this situation new materials had to be found. In fact, it took thousands of static tests of experimental motors to examine the many combinations of conventional and high-grade metals and non-metals before the design could be finalized.

Thrust Determination

Increasing the specific impulse of the propellent was one of the major problems. Aerojet-General are believed to have paid a good deal of attention to the ammonium perchlorate oxidizer for Polaris and are reported to have obtained specific impulses better than 250 and possibly as high as 270 with metal additives.

Another big problem was that of thrust determination. To ensure accuracy of the missile in hitting a specified target, thrust must be controlled and shut off precisely at a given time, according to the dictates of the missile's inertial guidance system.

This had always been a difficulty with solid propellents in that they operate at a fixed thrust, and there is difficulty of cutting off propulsion when required. The problem has been solved by an Aerojet patented invention which is believed to involve venting the Polaris second stage at the forward end, thereby drastically reducing pressure in the combustion chamber and causing almost instantaneous cut-off.



An Aerojet-General four-nozzle solid propellent engine is fired on static test.

SACRAMENTO SOLIDS.—Manufacturing a large solid propellent grain at Aerojet-General's Solid Rocket Plant, Sacramento, California.

1. The propellent, consisting of polyurethane fuel binder and oxidant, is put into a mixing tank; catalysts are added to hasten propellent curing.

2. The inert solid propellent batch is mixed mechanically, a process taking several hours.

3. After mixing, the still viscid propellent is removed to a waiting trailer.

4. At the Cast and Cure Building, it is finally cast into a rocket combustion chamber.

5. After casting the solid rocket chamber is prepared for delivery to the test area.

Nozzle controls

The first-stage propellent grain (reported to be 110-in. long x 53-in. diameter) exhausts through four nozzles. Each of these is fitted with a curved deflector called a Jetavator which can be moved into the efflux to control its direction and impart offset thrust for control purposes.

Stage two has a smaller propellent grain (said to be 47-in. long x 53-in. diameter) producing less thrust and probably operating for a longer period. The nozzle arrangement of this stage has not been revealed, but four vernier nozzles are discernible on a line about three-quarters up from the base of the cylindrical part of the missile body. The cut-off velocity would be about 10,000 m.p.h.

This potent propulsion system has been packaged into a missile reported to weigh about 29,000 lb., having an overall length of approximately 28 ft., and a maximum diameter of about 4 ft. 6 in. The overall dimension includes the cylindrical re-entry body and nose cone projecting from the tapered portion of stage two.

Optical Tracking of Vanguard I

ONE of the most remarkable achievements in the brief history of satellite tracking occurred last month when the Smithsonian Optical Tracking Station at Woomera successfully photographed the 6.4-in. Vanguard I satellite in orbit at a distance of nearly 2,500 miles.

No other object as small as this has previously been photographed from such a distance, which is comparable to aiming a camera at a golf ball 600 miles away.

The instrument responsible, the Baker-Nunn precision satellite-tracking camera, is one of 12 such instruments which have been set up in various parts of the World under the technical direction of the Smithsonian Astrophysical Observatory acting for the National Aeronautics and Space Administration. The tracking station at Woomera is operated by staff from the Missile Range.

The optical system of the giant camera, produced by Perkin-Elmer Corpn., consists of an ultra-fast f 1.0 apochromatic lens with a 20-in. aperture working in conjunction with a 31-in. concave mirror and three 20-in.-diameter correcting lenses. Its field of view is 30° to 5°, which is photographed on a strip of 55-mm. CinemaScope film about 1 ft. long. Further details of the camera operation are given in *Spaceflight*, July, 1959:

"Two pictures are taken on each strip of film; the first is taken while the camera is fixed on and following the satellite, giving a picture of the satellite as a point against a background of streaks from the brightest stars. The second exposure is made while the camera is fixed on the stars and moves with them, providing the reference from which the position of the satellite can be determined. The time to the nearest thousandth of a second is also recorded on the first picture. Once the controls have been set from a knowledge of the satellite's expected orbit, the operation of the camera is automatic and up to 100 separate exposures can be made during a single crossing of the satellite."

In a congratulatory note to the staff of the Woomera station, Dr. Hugh L. Dryden, the NASA's deputy administrator, said the tracking team's efforts demonstrated the true capabilities of the Baker-Nunn camera, thus paving the way for more accurate optical satellite-tracking data, essential to precise orbital calculations. From the extremely accurate information gathered by these cameras the Smithsonian Observatory expects to learn more about the density of the upper atmosphere and to be able to measure the shape of the Earth more accurately.

Despite its small size, Vanguard I, launched on March 17, 1958, contains radio equipment which is energized by six solar cells; this is still functioning. With a perigee of 402 miles, the satellite is currently making 76 orbits a week and during the week beginning May 17 it completed 4,590 revolutions of the Earth. Its life-time in orbit is now estimated at well over 200 years.

The 3-ton Smithsonian satellite-tracking camera which can locate a satellite in the sky within 2 sec. of arc.

Astronautics and Missile News

MISSILES FOR ITALY.—An initial batch of equipment for Nike SAMs arrived recently in Italy from the U.S. The Italian armed forces are also to receive Jupiter IRBMs. The cost of the missiles and training is borne by the U.S. Government.

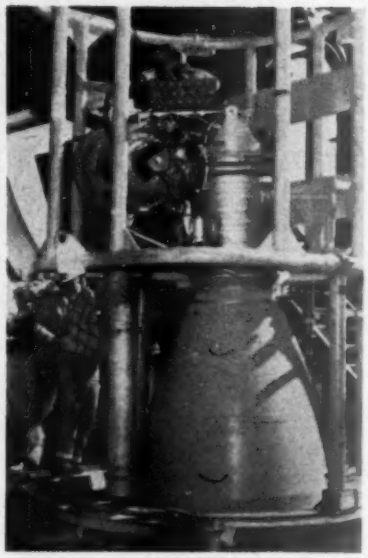
MISSILE "GHOST TOWNS."—North America's first electronic "ghost towns," each a silent guardian of an area greater than 100,000 sq. miles, will be armed with from 30 to 60 Bomarc missiles apiece. Each isolated site will be linked by underground cable to Air Force SAGE direction centres from 50 to 300 miles distant. Similar bases will be in Eastern Canada.

LUNAR LANDINGS.—It was the collective opinion of experts that it would take 10 to 15 years to put a man on the surface of the Moon, said Dr. Hugh Dryden, deputy administrator of the NASA, on May 24.

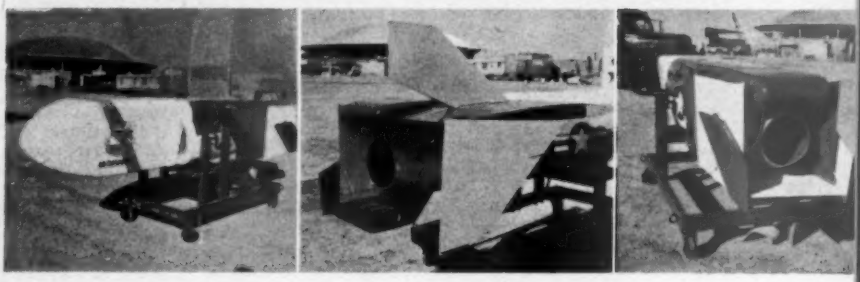
ROCKET FUEL. — Lt.-Gen. B. Shriever, U.S.A.F. chief of research and development, has announced that factories in Ohio, California and Florida are in production with a rocket fuel that produces three times the energy of present rocket fuels. It would allow substantial payload increases in upper stages of missiles and space vehicles, and has been made stable enough to overcome storage and transport risks.

LACROSSE ORDER.—The Orlando Division of The Martin Co. has received a production order worth $15,181,000 from the U.S. Army for Lacrosse missiles. This brings the total value of Lacrosse orders to more than $25 million. The first two battalions to use this artillery missile will be equipped by the end of this month.

ADOS.—A manœuvrable Earth-satellite (ADOS, after Astronautical Defensive-Offensive System) is being studied by the Crosley Division of Avco. Two counter-rotating rings surrounding a spherical crew chamber "can be used as a Vande Graff generator to place a charge on the vehicle, thus repelling charged particles."



FOR SATURN.—Eight of these Rocketdyne H-1 rocket engines (right) will be clustered to form the 1½-million-lb. thrust booster for the A.R.P.A's Saturn space-vehicle.



GAME BIRDS.—The McDonnell Quail decoy missile (2,000-lb. G.E. J85 turbojet) is 12 ft. 10 in. long, has a height of 2 ft. 1 in. and a width, at the tail, of 5 ft. 4 in. These pictures show the complete missile (left); one side of the tail folded (middle) and the Quail entirely folded for stowage in a Boeing B-52.

General Aviation News

BELGIAN SHOW. — The "Grand Critérium Internationale Aérien" to be organized by the R. Belgian Ae.C. at Gosselies, Brussels, on July 5 will include aerobatic, gliding, ballooning and model competitions. In the air display will be formation aerobatics by 16 Hunters of the R. Belgian A.F. and the U.S.A.F. Skyblazers in F-100s, and several new prototypes.

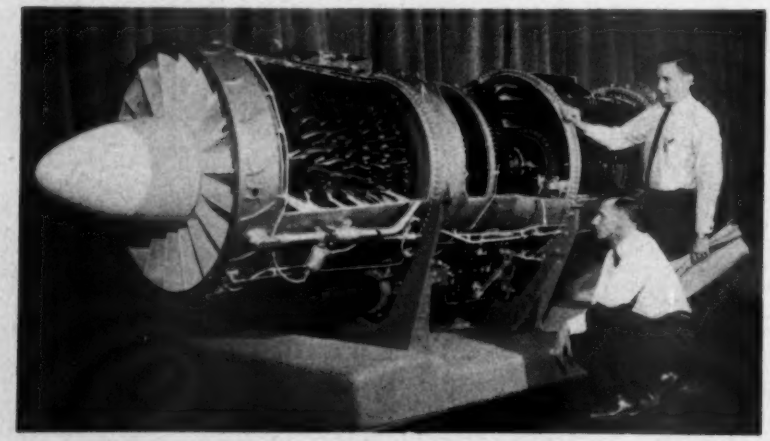
MINERAL SURVEY. — An aeromagnetic survey of Northern Ireland to seek coal and other mineral deposits is now being made. This is part of a three-four-year geophysical survey costing £110,000.

VANGUARD EQUIPMENT.—From Cory Brothers and Co., Ltd., comes news that an order for 60 Elliot inflatable escape chutes for T.C.A.'s Vanguards has been received. These chutes are inflated by aspirators made by the Walter Kidde company and use a lightweight air vessel made by Bristol Aerojet, Ltd.

NEW ITALIAN LIGHTPLANE.—The Aero Club of Italy is sponsoring manufacture of a new Aviamilano four-seater known as the P.19. It is a low-wing aircraft with nosewheel undercarriage.

NAME CHANGE. — The Aircraft Industries Association of America, Inc., has changed its name to Aerospace Industries Association of America, Inc.

LINNET GROUP.—A syndicate is being formed to purchase and operate a Garland-Bianchi Linnet at Biggin Hill. Estimated cost of flying is £2 15s. an hour. Details are available from Mr. J. Fleming, 26 Barclay Road, Croydon, Surrey.



TURBOJET DEBUT.—Seen at the World Congress of Flight at Las Vegas was this model of the Pratt & Whitney J75 turbojet, which develops a maximum of 26,500 lb. with water injection.

TACAN EXPANSION. — The Canadian Government has given the U.S. permission to install nine TACAN beacons in Canada. This agreement, which follows an exchange of notes between the two Governments, states that Canadian firms will manufacture as many of the electronic components as possible.

MACCHI IN ARGENTINA. — The first of 100 Macchi MB.308 light aircraft to be built in Argentina by the German Bianco concern has been completed.

INDUSTRIAL AGREEMENT.—The Goodyear Tyre and Rubber Co. (Great Britain), Ltd., and Electro-Hydraulics, Ltd., have concluded a manufacturing agreement whereby E-H are to produce all Goodyear-designed wheel, brake and associated hydraulic equipment formerly produced at Wallasey. Goodyear retains responsibility for design, modification and repair of all equipment except the hydraulic brake controls, which will be designed and made by E-H. The Goodyear factories at Wolverhampton and Hounslow are being expanded; aero-tyre production is not affected and will continue at Wolverhampton.

ISRAELI INTERCEPTION.—Mystère IVAs of the Israeli Defence Force/Air Force last week forced down a Savoia-Marchetti S.M.79 transport of the Lebanese Air Force at Haifa. The veteran trimotor S.M.79 landed after warning bursts had been fired by Israeli pilots, who claimed that the Lebanese machine was carrying photographic equipment.

Commercial Aviation Affairs

MAITLAND AIR CHARTERS.—Based at Biggin Hill, Maitland Air Charters, Ltd., started its operations on May 15, and offers an air taxi service for the businessman. The initial fleet comprises a four-seat Super Aero 45 and the first six-seat civil Aviation Traders Prentice (G-AOKF). Instruction is available on a Link D.4 simulator.

AIR SAFARIS MOVE.—The commercial and technical offices of Air Safaris are moving from London and Southend Airport to Gatwick Airport, with effect from June 1. The new address is Beehive Building, Gatwick Airport, Horley, Surrey. Telephone, Livingstone 8811.

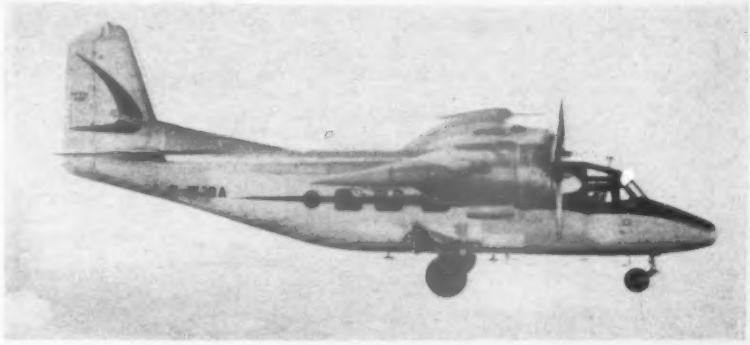
BUSY HELICOPTERS.—New York Airways fleet of five Vertol 44s has carried 100,000 passengers in a little less than a year's service. The airline has now transported over 300,000 passengers.

THE NEW RONGOTAI.—The first N.Z.N.A.C. aircraft will be operating through the new Wellington airport at Rongotai on July 20. The extended airport, which was illustrated in our issue of January 9, p. 37, is expected to be fully operational in October.

P-166 FOR AUSTRALIA.—Papuan Air Transport has ordered a Piaggio P-166 10-seat twin-engined transport to replace its DC-3 and Ansons at present in use.

T.A.A. F-27 IN SERVICE.—The first scheduled F-27 service by Trans-Australia Airlines was flown on May 1 between Canberra, Melbourne and Hobart. A second F-27 left Amsterdam on May 6 and a total of seven F-27s are due to reach Melbourne by the end of June.

JET SAFETY BARRIERS. — The F.A.A. Bureau of Research and Development has commissioned All American Engineering Co. to make a six-month evaluation of "pop-up" runway cable barriers for turbojet transports. Trials will be made at NAFEC Airport, Atlantic City.



FRENCH TWIN.—First flown on May 20, the Max Holste MH250 Super Broussard is among the exhibits at the Paris Aero Show. Powered by Pratt & Whitney R-1340 Wasp engines, it is a prototype for the MH260 turboprop version.

MELBOURNE AIRPORT.—A site for the new international airport at Melbourne has been selected at Tullamarine, near the existing airport and about 10 miles from the city centre.

MOSCOW-NEW YORK.—Reciprocal agreements between Aeroflot and Pan American for an over-the-pole service between Moscow and New York are likely to be concluded as soon as the Tu-114 is ready for service.

STOCKHOLM'S AIRPORT. — The new international airport for Stockholm, Arlanda, is expected to be ready for use in 1960 when S.A.S. will receive its first DC-8s. Initially the runway length will be 8,200 ft., but this will be extended later to 10,800 ft. When Arlanda is fully operational the present airport, Bromma, will be used mainly for intra-Scandinavian services.

ICELANDAIR IMPROVEMENT.—During 1958, Icelandair (Flugfelag Islands, H.F.) carried 4% more passengers on their international services to London, Glasgow, Hamburg, Copenhagen and Oslo, operated by Viscount.

CARACAS EXTENSION.—The runway at Maiquetia Airport, Caracas, Venezuela, is being extended from its present 7,015 ft. to 8,425 ft. as the first stage in a programme of extension and improvement.

EAGLE BROKERS.—With effect from June 1, H. Clarkson (Air and Shipping Services), Ltd., have been acting as Owner's Brokers for Eagle Aviation, Ltd., on the Baltic Exchange.

News About People

ATLAS APPOINTMENT. — Mr. Markham Jackson has joined Atlas Air Services, Ltd., in an executive capacity. Until recently, he was manager of Brompton Air Station for Airwork, Ltd.

MOND NICKEL CHANGES.—Dr. W. Betteridge has been appointed superintendent of the platinum metals research laboratory of the development and research department of the Mond Nickel Co., Ltd., as from June 1. The superintendent of the development and research department laboratory in Birmingham, Dr. W. Steven, was being transferred on the same day to the development and research division of the International Nickel Co., Inc., New York, as director of research; he is succeeded by Dr. G. L. J. Bailey.

SALES APPOINTMENT.—Mr. G. S. Parish has been appointed sales manager, London area (including home and eastern counties) of the David Brown Corporation (Sales), Ltd. He will be responsible for the sales of gear, foundry, machine-tool and precision-tool products, operating from 96-97 Piccadilly, London, W.1.

CAMBRIDGE APPOINTMENT. — Mr. I. H. Gordon has been appointed assistant sales manager of Cambridge Instrument Co., Ltd. He will operate from the company's head office in London. Previously he was southern area manager of Land Pyrometers, Ltd., and prior to that with Evershed and Vignoles. This appointment is part of an expansion of the company's sales organization with more liaison between head office and branches.

AIR B.P. NEWS.—Mr. E. G. Davidson (left) now aviation manager of Air B.P. was formerly manager of the technical services branch in London. Mr. J. Sanderson (right), formerly aviation manager of Air B.P., takes over as general manager of the B.P. associate in Sweden.

Correspondence

Let the Young See

TWENTY-EIGHT years ago, the most famous trophy of the air, the Schneider Trophy, was won outright by Britain. The youth of today, as always, copy the example we present to them. The Hurricanes and the Spitfires have disappeared. Modern aircraft fly so fast and so high that they cannot be seen.

This makes such reminders of past achievement as the Schneider Trophy doubly important. But where is it? Tucked away at the Royal Aero Club. Why not display it annually beside the machine at the Science Museum during Battle of Britain Week?

London, W.1. "EX-R.A.F. TYPE."

Fun in Flying

HAVING heard now so often, that well-equipped aeroplanes and a certain amount of comfort take "the fun out of flying"—I particularly hadn't expected it from John Fricker (Kidlington Quartet, May 22)—I should like to say that there seems to be a little more to it than just that.

The average private pilot here has probably never seen a parachute, never flown in an open cockpit, never sat through a loop, much less executed one, and I will readily admit that he misses these experiences. On the other hand he will pack the family in a Cessna 172 or Tripacer and hop down to Toronto, Boston or New York for the week-end, he will invariably hold night and radio ratings, he will navigate on airways and confidently talk his way into terminals of L.A.P. size.

The flying skills he employs are in my opinion—though different—just as specialized as taxying a Tiger Moth on a gusty day and the feeling of accomplishment as vivid after a "good" cross-country as after a properly executed roll. Fun in flying is meeting the challenge of the third dimension, strapped to a Bebe or Britannia.

May I add that I enjoy your magazine very much each week.

Montreal, P.Q. S. I. HESS.

A Fascinating Contest

MY interest in the types-flown championship now being promoted in your correspondence columns was whetted by your issue of May 22, in which a number of potential contenders were named. All of these have been my former C.I.s or colleagues in the test-flying world. Also all are ex-R.A.F. officers, which seems to imply that this battle is being regarded as an essentially light blue affair.

Not even the Silent Service can accept this situation, so I throw my log books in the arena as a dark blue contender. I might even be a dark horse, for although I have just crossed the 300-types-flown line I still have one ace card up my sleeve—I'm still on full active flying duty and in excellent position to continue to collect specimens.

This last statement may cause trouble to endless R.A.F. station commanders as my old friends dash round to plead for a quick buzz in a V-bomber or a rapid orbit in a Thor—"just to teach that darn sailor a lesson." Anyway, I hope it draws more challengers into the field in this fascinating paper contest.

B.F.P.O. 31, Germany. E. M. BROWN,
Commander, R.N.,
O.B.E., D.S.C., A.F.C., M.A., A.F.R.Ae.S.

Metal Bonding and the Avro 748

WE would be grateful for the opportunity to comment upon your preliminary notes on the Avro 748 (THE AEROPLANE, May 8, page 539). "Metal bonding" it is stated "was considered but is not used in the primary structure as it would make repairs difficult in the remoter parts of the World."

As makers of the Redux synthetic resin adhesives already used successfully in some 70 types of aircraft, we would challenge the validity of this opinion on the following grounds:—

(1) The experience of the aircraft manufacturers concerned shows that Redux bonded structures rarely need repairs. Bonding, by its nature, obviates loose rivets and consequent frettage and the structure is both stronger and more highly resistant to damage.

(2) In the unlikely event of repairs becoming necessary through unusual damage, recourse may be had to riveting in precisely the same way as if riveting had been employed in the first place. The employment of cold-setting structural adhesives such as Araldite for reinforcement is also a useful adjunct in field repairs.

One of the best examples of longevity in Redux-bonded aircraft is the Dove, and, as an example of operations "in remoter parts," Sudan Airways report complete freedom from failures on the part of their four remaining Doves which have aggregated 36,000 hours over the past 11 years.

Duxford, Cambs. K. S. MEAKIN.
(Publicity Manager, CIBA (A.R.L.), Ltd.)

Aden Air History

I AM in the process of compiling a history of Aden's airmails and air services and am in dire need of information relating to early flights and air services operating here.

The type of information I require is as follows and any part of it should prove most helpful:—

1. Any details of early flights or services operating to and from Aden.

2. Details of the private air service operated by Mr. Antonin Besse of A. Besse and Co. (Aden), Ltd., about 1936.

3. Full route and details of return journey (dates, etc.) of the following B.O.A.C. flights: 1/2R, 5/6R, 9/10R, 13/14R, 19/20R, 25/26R operating from Cairo to Aden and 1/2F from Asmara to Karachi.

4. Details of early R.A.F. flights and squadrons operating here.

My primary interest in all of the above is the carriage of mail, this being the reason for my research. I hope you will be able to find time and space to publish my "wants" and that you and your readers will be able to help. Any information, no matter how small, relating to the above will be most welcome.

c/o Post Office, 4117481 CPL. PEARMAN.
Royal Air Force,
Khormaksor,
B.F.P.O. 69.

Groundabout

"Well, don't just *stand* there . . . !" A highly technical-looking graph arrived at an airline's engineering headquarters accompanied by this note: "Please replace the attached chart with one already in your possession."

*

Amphibious Phred. My old friend, New Zealander Fred Ladd, who once flew me around Fiji in a Rapide at coconut height, tells me his one-Widgeon company Tourist Air Travel is prospering and is trying to get an import licence for another of the useful amphibians. Fred brings entertainment to air travel, so when you take your next holiday in N.Z., get him to meet your T.E.A.L. airliner at Auckland and waft you to Coromandel, Great Barrier, Waiheke Island, Rotorua, or any other lovely place you like to choose. T.A.T. could also stand for "Tonic Air Travel."

*

Missilese. "The schedule for students at H.Q. 1st Missile Division (SAC) Vandenberg Air Force Base calls for them to visit the greenhouse and check the doghouse. Then the chief engineer briefs them to magnaflux the elephant ears and test the kill switch before checking out the tranquillizers." Explanation?

Greenhouse: Check station where simulated flights are conducted.

Doghouse: Protuberance housing instruments on missile's otherwise smooth skin.

Elephant ears: Thick plates reinforcing hatches in the missile's body.

Kill switch: Device for shutting down an experiment when something goes wrong.

Tranquillizers: Instruments for stabilizing missile's "brains."

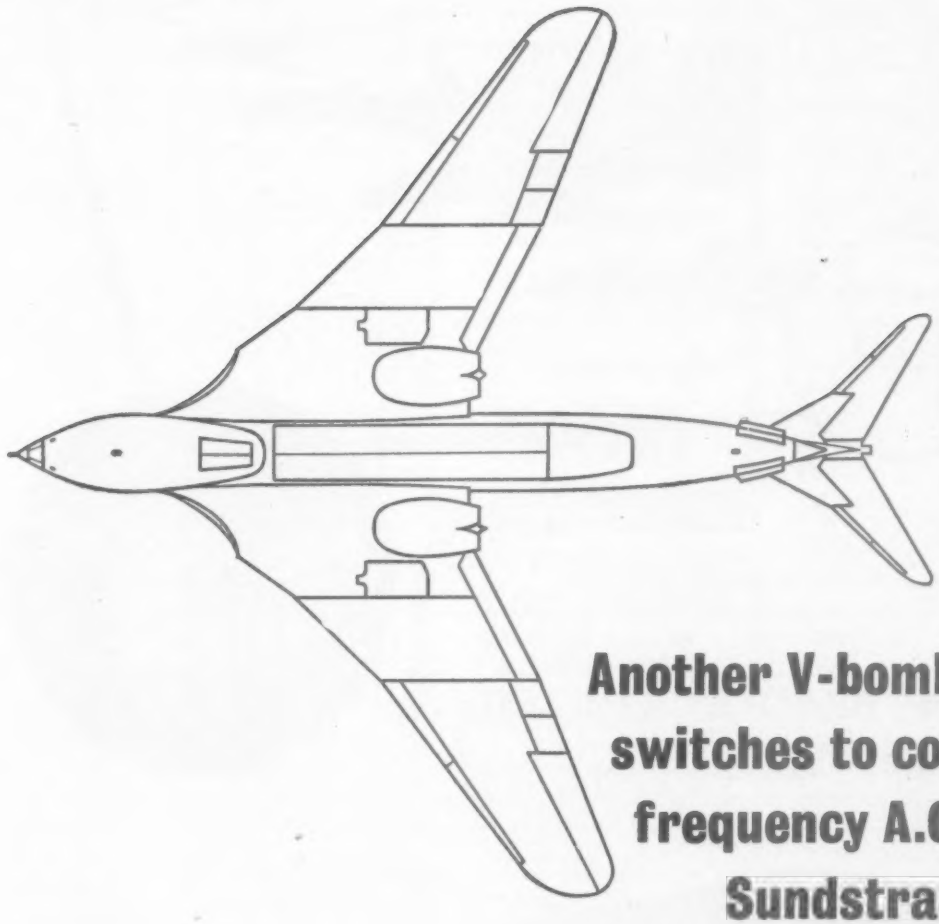
Brains: Missile's guidance system.

*

From My Favourite Line Book

"I haven't seen you in church lately, Ludlow."
"Now, now, Padre. No talking shop in the bar."

by Lorenzo



Another V-bomber switches to constant-frequency A.C. by Sundstrand

THE HANDLEY-PAGE VICTOR MARK II is the second of Britain's V-bombers to be fitted with the constant-frequency A.C. electrical generating system designed, developed and produced by the English Electric Aircraft Equipment Division.

Compared to the rectified A.C. system it has replaced, the English Electric system offers a considerable saving in weight, and also enables a simple and comprehensive protective system to be employed. It is capable of operating for long periods at high altitude with the minimum of maintenance.

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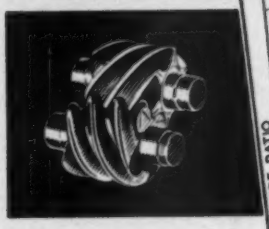

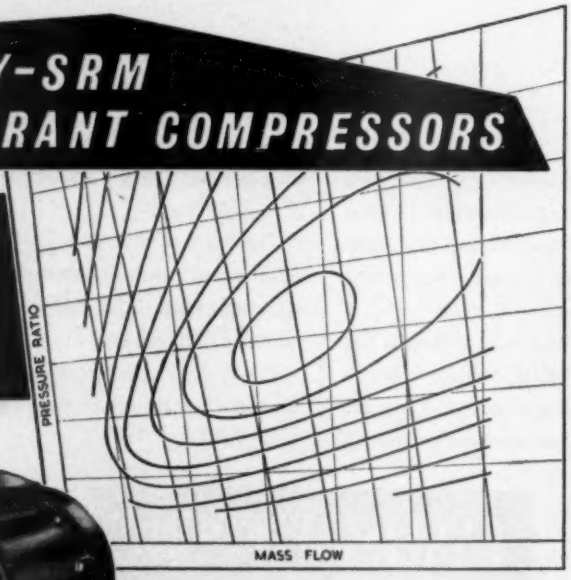

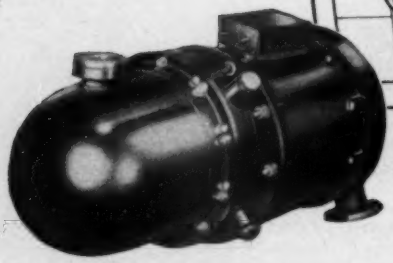

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NOTICES

AIR TRANSPORT ADVISORY COUNCIL.

THE AIR TRANSPORT ADVISORY COUNCIL give notice that they have received the undermentioned applications to operate scheduled air services:—

FROM AIR CHARTER, LTD., OF 21 WIGMORE ST., LONDON, W.1, for the following Vehicle Ferry Services to be operated with Bristol 170 and DC4 aircraft for the carriage of vehicles, freight and incidental passengers, for seven years from 1961 unless otherwise stated:—

APPLICATION No. 2569 on the route Southend-Calais (opt.)-Le Bourget at a frequency of up to six return flights daily from 1960.

APPLICATION No. 2570 on the route Southend-Rotterdam (opt.)-Bremen at a frequency of up to three return flights daily.

APPLICATION No. 2571 on the route Southend-Paris (opt.)-Tours at a frequency of two return flights daily.

APPLICATION No. 2572 on the route Southend-Calais (opt.)-Strasbourg at a frequency of two return flights daily.

APPLICATION No. 2573 on the route Southend-Calais or Paris (opt.)-Lyons at a frequency of up to three return flights daily.

APPLICATION No. 2574 on the route Southend-Calais or Paris (opt.)-Dijon at a frequency of up to three return flights daily.

APPLICATION No. 2575 on the route Southend-Ostend (opt.)-Dusseldorf at a frequency of up to four return flights daily from 1960.

FROM SILVER CITY AIRWAYS, LTD., OF 62 BROMPTON RD., LONDON, S.W.3:—

APPLICATION No. 2540 (amended) for a Vehicle Ferry Service with Bristol 170 aircraft for the carriage of vehicles, freight and incidental passengers on the route Lydd or Manston-Le Touquet (opt.)-Auxerre or Troyes at an initial frequency of three return flights daily increasing later in accordance with traffic demand, for ten years from Spring, 1960, and for permission to integrate the service with their existing Vehicle Ferry Service on the route Lydd or Manston-Le Touquet.

FROM ORION AIRWAYS, LTD., OF BLACKBUSHE AIRPORT, CAMBERLEY, SURREY, for the following services to be operated initially with Viking aircraft and later also with Viscount aircraft for the carriage of passengers, supplementary freight and mail for seven years from May 1, 1960:—

APPLICATION No. 2588 for a seasonal U.K. Internal Service between Coventry (Baginton) and Jersey at a frequency of six return flights weekly on Fridays, Saturdays and Sundays from May 1, to October 30, each year.

APPLICATION No. 2589 for a seasonal Normal Scheduled Service between Coventry (Baginton) and Dinard at a frequency of three return flights weekly on Fridays, Saturdays and Sundays from May 1 to September 30 each year.

FROM BRITISH OVERSEAS AIRWAYS CORPORATION OF LONDON AIRPORT, HOUNSLOW, MIDDLESEX:—

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